

# **CONSENSUS STANDARDS FOR COMMERCIAL DIVING AND UNDERWATER OPERATIONS**



**ASSOCIATION OF DIVING CONTRACTORS INTERNATIONAL**





# **CONSENSUS STANDARDS FOR COMMERCIAL DIVING AND UNDERWATER OPERATIONS**

**Fifth Edition**

**ASSOCIATION OF DIVING CONTRACTORS INTERNATIONAL**

- Communication
- Education
- Safety

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## FOREWORD

The members of the Association of Diving Contractors International have agreed to abide by these Consensus Standards for Commercial Diving Operations performed within the United States of America and its' possessions as well as member companies domiciled outside of the United States. These Consensus Standards are also recommended and encouraged for use by non-member companies engaged in the conduct of commercial diving operations, and by Flag States or other National bodies as guidance for the conduct of commercial diving operations.

These consensus standards represent the collective operating philosophy of several hundred ADCI member companies and have been carefully developed to present the Minimum Standards necessary for the conduct of a basic commercial diving operation conducted either Offshore or Inland. As in any activity for which Minimum Standards have been developed there can be no substitute for careful Planning and Assessment of the job to be conducted and the conditions likely to be encountered.

**In all cases it remains the responsibility of the Diving Supervisor of the dive team to ensure that provisions are made for an increase in manning or, in equipment necessary to conduct the designated operation in a manner consistent with the highest standards of safety.**

The ADCI Consensus Standards are based on current requirements of U.S. Federal regulations and also, the practices and procedures of the commercial diving industry as represented by more than 200 member diving companies. These Standards have been carefully developed to assure users a maximum degree of safety if their contents are carefully and continuously followed and are acknowledged as minimum standards which no diving operation should be conducted without.

**Nothing herein contained is intended to replace or supplant regulations, codes, or standards applied by Flag States or National bodies outside of the jurisdiction of the United States.**

**The Association of Diving Contractors International recognizes the validity of Codes and Standards developed by other recognized International organizations such as, but not limited to Ship Classification Societies, IMCA, IMO, Standards Institutes, etc. Member companies of this Association operating outside U.S. jurisdiction may have a need to follow such Codes and Standards prepared by others. However if required to also comply with other Standards or Codes, member companies remain pledged to comply with not less than the minimum requirements of these Standards in addition to whatever other requirements may be applied.**

Great care must be given to proper and complete planning and assessment of any commercial diving operation. These Standards set forth a minimum threshold below which no company should consider an operation to be safe. No set of standard procedures can anticipate all operating conditions that may be encountered and, consequently, no user of these Standards may assume safe operation simply by following these guidelines.

No standard can ever substitute for common sense, sound judgement, or a continuing concern for safety. Deviation from Standards and Codes should always be made on the side of increasing safety. In an emergency situation it is recognized that full compliance with Standards and Codes may not be possible. In such instances a carefully crafted emergency response plan must be implemented in order to minimize the risks.



## RECORD OF CHANGES

This fifth edition of the ADCI Consensus Standards for Commercial Diving Operations supersedes the Fourth Edition, dated 1992.

Change No.	Date	Description of Change	Page No.



## SPECIAL NOTE

A technical publication is of value only insofar as it is maintained in current, up-to-date condition. The Association of Diving Contractors International periodically updates the ***Consensus Standards for Commercial Diving and Underwater Operations*** to reflect new developments and procedures in the commercial diving and underwater operations fields. These updates will be in the form of periodic changes or major revisions, and recorded on the Record of Changes page and shall be published at [www.adc-int.org](http://www.adc-int.org) following approval of the Board of Directors.

Copies of the Consensus Standards for Commercial Diving and Underwater Operations are available from:

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All individuals, contractors, clients, members of the ADC International, or other bodies concerned with the safety of commercial diving and underwater operations are requested to submit constructive criticism and recommendations for improvement of the Standards to the above address. The ADCI Board of Directors is responsible for final approval of any changes to these consensus standards.

**For any issued errata or updates to this 5th Edition, go to the Association of Diving Contractors International website: [www.adc-int.org](http://www.adc-int.org).**







## SECTION 1.0

# GENERAL PROVISIONS





## **1.0 GENERAL PROVISIONS**

### **1.1 SCOPE AND APPLICATION**

#### **1.1.1 Purpose**

The primary purpose of these consensus standards is to contribute to the safety and well being of commercial divers and other personnel engaged in underwater operations.

These consensus standards apply to all types of work, whether onshore or offshore, involving commercial diving and underwater operations. It is intended that this standard will complement applicable government rules and regulations as well as supplement industrial codes of safe practice for diving and underwater operations.

Nothing contained in this manual shall be construed to take the place of any law, rule, or regulation of any governmental agency authorized to implement such regulations on behalf of its nation.

#### **1.1.2 Preservative Acts**

It is expressly provided and declared that in an emergency situation requiring the saving of personnel, any operating company, its officers, directors, agents, or employees may act in variance with the operating procedures and recommendations established in this standard.





## SECTION 2.0

# PERSONNEL REQUIREMENTS





## 2.0 PERSONNEL REQUIREMENTS

### 2.1 GENERAL

Each person engaged in diving and underwater operations shall possess the necessary qualifications for the job assignment. Designation of skill levels in these standards incorporates three primary elements:

- Technical Proficiency
- Field Experience
- Demonstrated Proficiency

Persons assigned to specific diving and underwater activities shall possess the following:

1. Knowledge and skills gained through a combination of formal training and/or experience in the following:
  - Diving Procedures and Techniques
  - Emergency Procedures
  - Physiology and Physics as They Relate to Diving
  - Diving Equipment
  - First Aid and CPR
  - Electronics (ROV Operations)
  - Computer Technology (ROV Operations)
  - Hydraulics (ROV Operations)
  - Mechanics (ROV Operations)
2. Familiarity with procedures and proficiency in the use of tools, equipment, devices, and systems associated with the assigned tasks.

**Personnel trained and certified by recreational agencies such as, but not limited to the National Association of Underwater Instructors [NAUI], the Professional Association of Diving Instructors [PADI], the Young Mens' Christian Association [YMCA], or other such organizations are not sufficiently well trained to participate in or conduct commercial diving activities without additional formal training.**

3. For persons engaged as divers or otherwise exposed to hyperbaric conditions, physical qualifications for such activities must be met as outlined in **Paragraph 2.8 Medical Requirements**, and detailed in **Paragraph 2.9 entitled Medical Standards and Recommendations**. Such physical qualifications must be documented on an Association of Diving Contractors International **Medical History and Physical Examination Form**, or equivalent.

**A person lacking the required experience and proficiency outlined above may be assigned a task under the direction of an experienced and qualified individual in order to obtain the experience and level of proficiency required.**

4. For persons that operate decompression chambers, knowledge of chamber operations.
5. For persons involved in ROV operations knowledge of:
  - ROV Construction
  - ROV Launch and Recovery
  - ROV Limitations
  - ROV Crew Responsibilities
  - ROV Electrical Hazards



## 2.2 ENTRY-LEVEL QUALIFICATIONS

Personnel entering the profession of commercial diving or remote operated vehicle operations should be a high school graduate or equivalent. The entry-level minimum skill designation on the diving crew is a Tender/Diver and on an ROV crew is a ROV Pilot/Technician. The entry-level Tender/Diver satisfies the minimum entry level qualifications of Diving Proficiency, Technical Proficiency, and Experience by successfully completing a formal course of study. The Tender/Diver must also complete the requirements of **Paragraph 2.1.3**. The entry-level ROV Pilot/Technician must have completed formal or equivalent training of 287 hours of instruction in subjects appropriate to his profession.

A formal course of study for a Tender/Diver shall be completed at any accredited school, military school, or equivalent whose curriculum, as a minimum, includes the following:

**Note:** The U.S. Department of Labor (OSHA) considers an employer to be in compliance with the Code of Federal Regulations if documentation shows that the diver completed an accredited training program to the appropriate level (i.e., surface-supplied air or surface-supplied mixed gas) at a commercial diving school within a particular state, a military school, a government school, or an Association of Commercial Diving Educators (ACDE) accredited school.

An employer is also in compliance when documented evidence attests to the training level of employed divers under the national consensus standard published by the American National Standards Institute (ANSI) and the Association of Commercial Diving Educators (ACDE); ANSI/ACDE-01-1998 American National Standard for Divers Commercial Diver Training—Minimum Standard.

OSHA considers an employer to be in compliance with the diver training requirements of the Code of Federal Regulations for any employed diver with a valid “ADC Commercial Diver Certification Card” for the appropriate training level.

### **SUBJECT: ENTRY-LEVEL TENDER/DIVER**

### **HOURS**

• Principles of Diving Physics	12.5
• Formula Application	12.5
• Air Decompression Tables and Decompression Procedures	30
• Anatomy and Physiology Related to Diving	18
• Diving Diseases, Injuries, and Psychological Aspects	12
• Treatment of Diver's Illness and Injuries	30
• First Aid for Divers and CPR	16
• Noxious Gases in Enclosed Spaces	2
• Environmental Hazards of Diving	12
• Hyperbaric Chamber and Associated Equipment	16
• Lightweight Diving Equipment Function and Nomenclature	24
• Lightweight Diving Procedures and Techniques	40
• Operations Planning	12
• Diving Logs, Records, and Standards for Commercial Diving Operations	12
• Drawings, Blueprint Reading, Report Writing	8
• Mixed Gas Diving	30
• Introduction to Underwater Cutting and Welding	24
• Industrial and Offshore Safety	6

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<b><u>SUBJECT: ENTRY-LEVEL ROV PILOT/TECHNICIAN</u></b>	<b><u>HOURS</u></b>
• First Aid/CPR	8
• High Voltage	8
• Industrial Hydraulics	45
• Fiber Optics	8
• Lock-Out/Tag-Out	4
• Sonar	4
• Rigging	8
• Policy/Standards	24
• Mobilization/Demobilization	8
• Field Training	50
• Basic Electricity/Electronics	<u>120</u>
Total:	287

The Association of Diving Contractors International also recognizes formal training certificates including, but not limited to:

**Surface-Supplied Diver Certificates:**

- Australian Diver Accreditation Scheme Part 3
- Canadian Category 1 Diver
- Canadian Surface-Supplied Mixed Gas Diver to 70m
- Canadian Unrestricted Surface-Supplied Diver to 50m
- Dutch Part 1 Surface Dependent Diver
- Finland National Surface Supply Division
- Denmark Surface Supplied Diver to 50m
- French Class 2
- HSE Surface-Supplied (with offshore top up)
- HSE Part I (Transitional Part 1 — issued between 7/1/81 and 12/31/81)
- Italy OTS.BF
- New Zealand Part 1
- Norwegian NPD Surface Diver
- South African Class II

**Closed Bell Diver Certificates:**

- Australian Diver Accreditation Scheme Part 4
- Canadian Bell Diver
- Canadian Category 2 Diver
- Canadian Category 3 Diver
- Dutch Part 2 Bell Diver
- French Class 3
- HSE Part II (Transitional Part II — issued between 7/1/81 and 12/31/81)
- HSE Closed Bell
- Italy OTS.AF
- New Zealand Part 2
- Norwegian NPD Bell Diver
- South African Class I

Persons possessing certificates identified above are entitled to apply for the Association of Diving Contractors International Commercial Diver Certification Card as outlined in this Standard. This certification card identifies the bearer as a formally trained commercial diver or ROV pilot/technician at the entry-level category. Certification categories of a higher level may be issued to individuals based upon verifiable and documented evidence of having completed the prerequisites for that category.



Personnel previously employed in commercial diving or ROV activities who do not meet the training qualification set forth herein must be certified by the employing contractor as having achieved an equivalent degree of training through a combination of field experience and formal classroom training as supported by validating documentation.

The Association of Diving Contractors International does not perform as an educational organization and as such, does not endorse, certify, or accredit any school participating in the training of personnel. Member schools are expected to obtain and preserve appropriate accreditation from agencies under whose jurisdiction their educational requirements must be maintained and further, to provide instruction as established under recognized guidelines such as ANSI/ACDE 01 (current version).

## 2.3 MINIMUM REQUIRED EXPERIENCE AND PROFICIENCY

1. **Advancement** beyond the designation of Tender/Diver requires completion of actual participation in commercial diving operations and demonstrated proficiency during working dives. Additional required technical qualifications are detailed separately in **Paragraph 6.28, Specific Operations Procedures** for the appropriate diving mode under the heading **Minimum Qualifications of Personnel**.
2. **Field Experience** is defined as those days spent (offshore, inland lakes, harbors, rivers, etc.) participating as a crew member in diving operations at the level of competency determined by prior training and demonstrated proficiency.
3. **Diving Proficiency** establishes the required minimum number of open-water working dives required to obtain various designations. All dives must be performed during a 24-month period immediately prior to issuance of the designation. Work must be performed during each dive with proper supervision. All dives must have a minimum of 20 minutes bottom time. A number of shorter duration dives may be combined to equal one dive of the required 20 minute bottom time.
4. **Advancement** to higher designations requires completion of training and experience for all lower designations.
5. **Other personnel**, in general terms, involved in underwater operations but not as commercial divers shall be required to follow a like program leading to a determination of competency.

### Minimum Qualifications:

- **Entry-Level Tender/Diver**  
Formal commercial diver training of at least 317 documented hours of formal instruction in subjects set forth above.
  - **Entry-Level ROV Pilot/Technician**  
Formal training consisting of at least 287 documented hours of formal instruction in subjects set forth below.
  - **Surface-Supplied Air (Mixed Gas) Diver**
1. To advance beyond the level of entry-level Tender/Diver an individual who **has not** received at least a total of 625 hours of formal training at an accredited school, military school, or equivalent, must complete additional on-the-job training of a recorded nature in the following subjects/disciplines with this training to be verified by the employer:

**SUBJECT****HOURS**

• Trainee Participation in Chamber Operations	44
• Seamanship & Rigging Fundamentals	25
• Practical Application of Seamanship and Rigging	60
• Maintenance of Diver's Umbilical	12
• Underwater Work Using Lightweight Diving Equipment	65
• Underwater Tools	24
• Hot Water Systems	2
• Introduction to Topside Welding	26
• Topside Welding Equipment	12
• Oxygen Acetylene Cutting Techniques	10
• Practical Application of Oxygen-Acetylene Method of Cutting	12
• Marine Engines and Compressors	16

Total: 308

2. Technical proficiency appropriate to the specific diving mode as outlined in **Paragraph 3.5, Specific Operations Procedures.**
3. A minimum of 100 Field Days Total for [Air Diver] or, a minimum of 100 Field Days of Air diving plus 50 Field Days of Mixed Gas activity for [Mixed Gas] Divers.
4. A minimum of 30 Working Dives Total for [Air Diver] or, a minimum of 50 Working Dives on air plus 10 dives on Mixed Gas for [Mixed Gas Diver].
  - Others
 

Technical proficiency as appropriate to the specific diving mode as detailed under the ADCI Certification Card Program requirements or appropriate section to these standards.

To advance beyond the level of Entry-Level ROV Pilot/Technician an individual must perform in the operational environment to gain specific knowledge and demonstrate an ability to pilot an ROV. The specific number of field days and piloting hours together with a description of knowledge-based requirements are set forth in this standard.

## 2.4 DIVER'S PERSONAL LOG BOOKS

All divers shall maintain a personal dive log book (ADCI Commercial Diver Log Book) or equivalent to detail hyperbaric exposures. The Log Book must be identified to the diver using it by photograph, signature, and home address. As a minimum, the following information shall be entered in the Log Book:

- Diving contractor's name and address
- Date of the dive
- The name or other designation and location of the diving site or vessel from which the diving operation was carried out
- Maximum depth reached on the dive
- The time left surface, bottom time, and the time reached surface for each hyperbaric exposure
- Surface interval, if dive includes time for decompression
- Type of breathing apparatus and breathing mixture used
- Task performed
- Type of designation of the decompression table and schedule used



- Any DCS or injury incurred during the dive
- Comments section
- Diver's signature
- Supervisor's signature
- Place for a counter-signature or stamp of the diving company

Additional pages must be provided to show:

- Dates of diving physicals, signed by the examining physician
- A record of all relevant training sessions
- A record of all equipment testing and maintenance
- A record of the diver's helmet type, serial number, and verified completion of annual helmet inspection as required by the equipment manufacturer

The diver shall present his personal Log Book to company authorities for verification and stamping at quarterly, but not less than annual intervals.

## 2.5 ROV PERSONNEL LOG BOOKS

ROV personnel shall maintain a personal Dive Log to record the following minimum information:

- Date of the dive
- Job title at time of dive
- ROV company for whom the job was performed
- ROV type, name and serial number
- Dive number
- Location from which dive was performed
- Dive depth
- Dive work description
- Time duration of dive

Each Log Book entry should be approved by the on-site supervisor or manager. If one is not onsite, it is the ROV operator's responsibility to have the logged dives approved at the earliest opportunity.

It is the ROV operator's responsibility to properly maintain his personal Log Book at all times and to have that Log Book present at the site of each job.

## 2.6 DESIGNATED DIVING SUPERVISOR

The diving supervisor for each commercial diving operation shall be designated in writing in a form that can be viewed by competent authorities and his or her identity made known to the person in charge through personal communication prior to the commencement of any commercial diving operation. A copy of the written designation of the diving supervisor shall be made available for delivery to competent authorities on arrival at the job site.

1. A qualified person shall be designated in charge of each diving operation.
2. The responsibilities of such designated persons should include job planning, coordination, record keeping, and proper response to any job-related emergency, as well as knowledge of the appropriate governmental regulatory agency regulation. [See **Duties of the Diving Supervisor**]

## 2.7 DESIGNATED ROV SUPERVISOR

The ROV supervisor for each operation shall be designated in writing in a form that can be viewed by competent authorities and his or her identity made known to the person in charge through personal communication prior to commencement of any ROV operation. A copy of the written designation of the ROV supervisor shall be made available for delivery to competent authorities on arrival at the job site.

1. A qualified person shall be designated in charge of each ROV operation.
2. The responsibilities of such designated person should include organization/management of the team, accident reporting, effective use of the safety management system, knowledge of appropriate regulations, and training of personnel under supervision. [See **Duties of the ROV Supervisor**]

## 2.8 MEDICAL REQUIREMENTS

### 2.8.1 General

For persons engaged as divers, or otherwise subjected to hyperbaric conditions, the following ADCI medical examinations (or equivalent) are required:

1. An initial medical examination except as provided in **Paragraph 2.9.2** below
2. Periodic examinations:  
Recommended annually, minimum every two years  
Annually after thirty-five years of age
3. A re-examination after a diving-related injury or illness as needed to determine fitness to return to diving duty

### 2.8.2 Physical Examination

1. For persons engaged as divers or otherwise subjected to hyperbaric conditions, the initial exam and periodic medical re-examination include the following:
  - Work history
  - The tests required in **Table 1** as appropriate (2.8.4)
  - Any tests deemed necessary to establish the presence of any of the disqualifying conditions listed in **Paragraph 2.8.6** of this section
  - Any additional tests the physician deems necessary to prepare the written report required by **Paragraph 2.8.5** of this section
2. If within one year the person has had a comprehensive medical examination comparable to the initial examination specified by this section, and if the results of this examination did not indicate the presence of significant abnormalities affecting the organs, systems, or general health of the person, or any of the conditions in **Paragraph 2.8.6** of this section, said examination will be deemed necessary to this examination unless there have been any incidents (illness, accidents, etc.) during the course of that year that may have led to a change in the medical condition of the individual. In such an instance, a complete medical re-examination shall be required.

### 2.8.3 Re-examination after Injury or Illness

1. Any person engaged as a diver, or otherwise exposed to hyperbaric conditions, will have a medical examination following a known diving-related injury or illness which requires hospitalization of 72 hours or more (unless national or local laws dictate otherwise),



2.8.4 Table 1—Medical Tests for Diving

Test	Initial	Periodic	Comments
<b>History &amp; Physical</b>	X	X	Include predisposition to unconsciousness, vomiting, cardiac arrest, impairment of oxygen transport, serious blood loss, or anything which in the opinion of the examining physician will interfere with effective underwater work.
<b>Chest X-Ray</b>	X	X	PA & LAT (Projection: 14" x 17" minimum)
<b>Bone &amp; Joint X-ray Survey</b>	X		Required initially and as medically indicated.
<b>EKG: Standard (12 Leads)</b>	X		Required initially to establish baseline, annually after age 35, and as medically indicated.
<b>EKG: Stress Test</b>			Required only as medically indicated.
<b>Pulmonary Function</b>	X	X	Required
<b>Audiogram</b>	X	X	Threshold audiogram by pure tone audiometry; bone conduction audiogram as medically indicated.
<b>EEG</b>			Required only as medically indicated.
<b>Visual Acuity</b>	X		Required initially and as medically indicated.
<b>Color Blindness</b>	X		Required initially.
<b>Hematocrit, Hemoglobin, White Blood Count</b>	X	X	
<b>Routine Urinalysis</b>	X	X	

or known decompression sickness with audio-vestibular, central nervous system dysfunction, or arterial gas embolism.

2. The person should not be permitted to return to work as a diver, or otherwise be subjected to hyperbaric conditions, until he is released by a physician to do so.
3. The examining physician should determine the scope of the examination in light of the nature of the injury or illness.

### 2.8.5 Physician's Written Report

A written report outlining a person's medical condition and fitness to engage in commercial diving or other hyperbaric activities should be provided by the examining physician at any time a physical examination is required herein. The written **Physical Examination Form** should be accompanied with a completed copy of the standard **ADCI Medical History Form** or its equivalent.

The examining physician should be qualified by experience or training for the conduct of commercial diver physical examinations and if not, should consult with another medical practitioner so qualified.

### 2.8.6 Disqualifying Conditions

A person having any of the following conditions, as determined by a physician's examination shall be disqualified from engaging in diving or other hyperbaric activities.

- History of seizure disorder other than early childhood febrile conditions
- Cystic or cavitary disease of the lungs, significant obstructive or restrictive lung disease, or recurrent pneumothorax
- Chronic inability to equalize sinus and middle ear pressure
- Significant central or peripheral nervous system disease or impairment
- Chronic alcoholism, drug abuse, or history of psychosis
- Significant hemoglobinopathies
- Significant malignancies
- Grossly impaired hearing
- Significant osteonecrosis
- Chronic conditions requiring continuous control by medication
- Pregnancy

### 2.8.7 Withdrawal from Hyperbaric Conditions

It shall be determined on the basis of the physician's examination, whether a person's health will be materially impaired by continued exposure to hyperbaric conditions. The physician should indicate any limitations or restrictions which would apply to the person's work activities in his written report.

### 2.8.8 Medical Record Keeping

1. An accurate medical record for each person subject to the medical specifications of this section should be established and maintained. The record should include those physical examinations specified herein including the **ADCI Medical History/Physical Examination Forms** and the physician's written report.
2. The medical record shall be maintained for a minimum of five years from the date of the last hyperbaric exposure unless otherwise prescribed by law.





## 2.9 MEDICAL STANDARDS AND RECOMMENDATIONS

### 2.9.1 Introduction

The following recommendations are set forth by the Association of Diving Contractors International and are intended to be used with the **ADCI Medical History/Physical Examination Forms**. They deal with specific aspects of the subject's physical fitness to dive by item number. These standards are offered with what we believe, in most cases, to be the minimum requirements. The use of these standards is intended to be tempered with the good judgment of the examining physician. Where there is doubt about the medical fitness of the subject, the examining physician should seek the further opinion and recommendations of an appropriate specialist in that field. Particular attention must be paid to past medical and diving history. In general, a high standard of physical and mental health is required for diving. Consequently in addition to excluding major disqualifying medical conditions, examining physicians should identify and **give careful consideration** to minor, chronic, recurring or temporary mental or physical illnesses which may distract the diver and cause him to ignore factors concerned with his own or others safety.

Height in. (cm)	Max. Weight lbs. (kg)	Height in. (cm)	Max Weight lbs. (kg)
64 (162.56)	164 (73.80)	72 (182.88)	205 (92.25)
65 (165.10)	169 (76.05)	73 (185.42)	211 (94.95)
66 (167.64)	174 (78.30)	74 (187.96)	218 (98.10)
67 (170.18)	179 (80.55)	75 (190.50)	224 (100.80)
68 (172.72)	184 (82.80)	76 (193.04)	230 (103.50)
69 (175.26)	189 (85.05)	77 (195.58)	236 (106.20)
70 (177.80)	194 (87.30)	78 (198.12)	242 (108.90)
71 (180.34)	199 (89.55)		

The spectrum of commercial diving includes industrial tasks performed from just below the surface to deep saturation diving. Job descriptions and therefore job-limiting disabilities may vary widely. These standards, in general, apply to all divers. Some consideration must be given to the subject's medical history, work history, age, etc.

There is no minimum or maximum age limit providing all the medical standards can be met. ADCI does, however, restrict issue of Commercial Diver Certification Cards to persons 18 years of age or older. Serious consideration must be given to the need for all divers to have adequate reserves of pulmonary and cardiovascular fitness for use in an emergency. The lack of these reserves may possibly lead to the termination of a professional diving career. The examining physician should exercise the appropriate professional judgment to determine whether, in particular circumstances, additional testing may be warranted. Disqualification for an inability to meet any of these standards must be determined on a case-by-case basis related only to the specific job functions of the position being applied for, and assuming reasonable accommodations cannot be made.



Upon application by a company or individual, and with concurrence by the examining physician, particular medical circumstances may justify that a variance be granted until the diver's next periodic diving physical. At that time the permitted variance is to be subject to the examining physician's review and comment. Examining physicians must have a list of the essential job functions (Job Description) to review with each commercial diving physical examination. The examining physician is encouraged to make any recommendations for reasonable accommodations necessary for a person to meet these standards.

The numbered items within these standards refer to boxes on the **ADCI Medical History/Physical Examination Form**. These forms are available from the offices of the ADCI and should be used by all physicians conducting ADCI Diving Physical Examinations.

If any further clarification of this recommended standard is desired please contact the Association of Diving Contractors International.

### 2.9.2 ADCI Physical Examination Standards

Patient history is recorded on pages 2-19 thru 2-20 of the form set. Pages 2-21 and 2-22 are used to record specific findings during the conduct of the examination.

The following headings refer to and explain the numbered boxes on the **ADCI Physical Examination Form** on pages 2-21 and 2-22. A sample copy of these forms is enclosed in this standard. Use of these forms ensures quality and consistency throughout the commercial diving industry. These forms may be obtained from the office of the ADCI.

#	1	<b>Name</b>	Record.
#	2	<b>Social Security Number or Passport Number</b>	Record.
#	3	<b>Height</b>	No set limits.
#	4	<b>Weight</b>	The weight standards listed below should apply. If a diver exceeds these standards and the cognizant physician feels the increase is due to muscular build and physical fitness, a variance is appropriate. Furthermore, individuals who fall within these weight standards but who present an excess of fatty tissue should be disqualified.
#	5	<b>Temperature</b>	The diver should be free of any infection/disease which would cause an abnormal temperature.
#	6	<b>Blood Pressure</b>	Ideally the resting blood pressure should not exceed 140/90 mm Hg. In cases of apparent hypertension repeated daily blood pressure determinations should be made before a final decision is made.
#	7	<b>Pulse/Rhythm</b>	Persistent tachycardia, marked arrhythmia except of the sinus type, or other significant disturbance of the heart or vascular system should be disqualifying.
#	8	<b>Hygiene</b>	Should be good.
#	9	<b>Nutrition</b>	Should be good.
#	10	<b>Build</b>	Record.



# 11	<b>Distant Vision</b>	Should have vision corrected to 20/40, O.U. in both eyes.
# 12	<b>Near Vision</b>	Uncorrected - J16.
# 13	<b>Color Vision</b>	Record.
# 14	<b>Field of Vision</b>	Should be normal, with any discrepancies documented.
# 15	<b>Contact Lenses</b>	Record if used.
# 16	<b>Head, Face, and Scalp</b>	The causes for rejection may be: <ul style="list-style-type: none"> <li>a) Deformities of the skull in the nature of depressions, exostosis, etc., of a degree which would prevent the individual from wearing required equipment.</li> <li>b) Deformities of the skull of any degree associated with evidence of disease of the brain, spinal cord, or peripheral nerves.</li> <li>c) Loss or congenital absence of the bony substance of the skull.</li> </ul>
# 17	<b>Neck</b>	The cause for rejection may be: <ul style="list-style-type: none"> <li>a) Cervical ribs if symptomatic.</li> <li>b) Congenital cysts of bronchial cleft origin or those developing from the remnants of the thyroglossal duct, with or without fistulous tracts.</li> <li>c) Fistula, chronic draining, of any type.</li> <li>d) Spastic contraction of the muscles of the neck of a persistent and chronic nature.</li> </ul>
# 18	<b>Eyes</b>	Active pathology or previous eye surgery may be cause for restriction or rejection.
# 19	<b>Fundus</b>	No pathology.
# 20	through # 24 <b>Ears, Nose, Throat, and Eustachian Tube</b>	The following conditions are disqualifying: acute disease, chronic serious otitis or otitis media, perforation of the tympanic membrane, (#23), any significant nasal or pharyngeal respiratory obstruction, chronic sinusitis if not readily controlled, speech impediments due to organic defects, or inability to equalize pressure due to any cause.
# 25	<b>Mouth</b>	<ul style="list-style-type: none"> <li>a) Candidate should have a high degree of dental fitness; any abnormalities of dentition or malformation of the mandible likely to impair the diver's ability to securely and easily retain any standard equipment mouthpiece should disqualify.</li> <li>b) Removable dentures should not be worn while diving</li> <li>c) Record the date of the most recent dental X-rays. Record the dentist's name and address to enable X-ray location if needed for post-mortem identification.</li> </ul>

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| # 26 | <b>Lungs and Chest<br/>(Include Breasts)</b> | Pulmonary: congenital and acquired defects which may restrict pulmonary function, cause air entrapment, or affect the ventilation-perfusion balance shall be disqualifying for both initial training and continuation. In general, chronic obstructive or restrictive pulmonary disease of any type shall be disqualifying.  |
| # 27 | <b>Heart (Thrust, Size, Rhythm, Sounds)</b>  | Cardiovascular system: there should be no evidence of heart disease. Any arrhythmias must be fully investigated.   |
| # 28 | <b>Pulse</b>                                 | Record.  |
| # 29 | <b>Vascular</b>                              | Cardiovascular system: The cardiovascular system shall be without significant abnormality in all respects as determined by physical examination and tests as may be indicated. Persistent tachycardia and arrhythmia except sinus type, evidence of arteriosclerosis (an ophthalmoscopic examination of the retinal vessels shall be included in the examination), severe varicose veins, and marked symptomatic hemorrhoids may be disqualifying. |
| # 30 | <b>Abdomen<br/>and Viscera</b>               | <ul style="list-style-type: none"> <li>a) Peptic ulceration should be a cause for rejection unless healed and the candidate has been asymptomatic for at least three months without supportive medication.</li> <li>b) Any other chronic gastrointestinal disease (i.e., ulcerative colitis, cholelithiasis) should be cause for rejection.</li> </ul>   |
| # 31 | <b>Hernia</b>                                | Any significant abdominal herniation should be cause for rejection until satisfactory repair has taken place.  |
| # 32 | <b>Endocrine System</b>                      | Any endocrine disorder requiring daily or intermittent medications for control is disqualifying. Diabetes mellitus, either insulin, oral hypoglycemic agent, or diet controlled is disqualifying.  |
| # 33 | <b>G.U. System<br/>(Genital-urinary)</b>     | <ul style="list-style-type: none"> <li>a) Venereal disease will disbar until adequately treated.</li> <li>b) Evidence or history of nephrolithiasis must be fully investigated and treated.</li> <li>c) Evidence or history of urinary dysfunction or retention must be fully investigated and treated.</li> </ul>   |
| # 34 | <b>Upper Extremities</b>                     | Any impairment of musculoskeletal function should be carefully assessed against the general requirements which would interfere with the individual's performance as a diver.   |
| # 35 | <b>Lower Extremities</b>                     | Any impairment of musculoskeletal function should be carefully assessed against the general requirements which would interfere with the individual's performance as a diver.   |



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| # 36 | <b>Feet</b>                            | Any impairment of musculoskeletal function should be carefully assessed against the general requirements which would interfere with the individual's performance as a diver.  |
| # 37 | <b>Spine</b>                           | Any impairment of musculoskeletal function should be carefully assessed against the general requirements which would interfere with the individual's performance as a diver.  |
| # 38 | <b>Skin-Lymphatic</b>                  | There should be no active acute or chronic disease of the skin or lymphatic system.   |
| # 39 | <b>Anus and Rectum</b>                 | Any conditions which interfere with normal function, i.e., stricture, prolapse, severe hemorrhoids, may be disqualifying.   |
| # 40 | <b>Sphincter tone</b>                  | Note and record.  |
| # 41 | <b>Pelvic Exam</b>                     | Must be within limits. Pregnancy at any stage may be disqualifying. Any menstrual disorder manifested by abnormal or prolonged bleeding, as well as excessive pain may be disqualifying.  |
| # 42 | <b>Neurological<br/>Sensorium Exam</b> | A full examination of the central and peripheral nervous system should show normal function, but localized minor abnormalities, such as patches of anesthesia, are allowable provided generalized nervous system disease can be excluded. Any history of seizure (apart from childhood febrile convulsions), intracranial surgery, loss of consciousness, severe head injury involving more than momentary unconsciousness or concussion, should be cause for rejection. If the severity of head injury is in doubt, special consultation and studies should be considered. |
| # 43 | <b>Cranial Nerves</b>                  | Examine and record.   |
| # 44 | <b>Reflexes</b>                        | Should be normal and free from pathology. Document any abnormalities.   |
| # 45 | <b>Cerebral<br/>Function</b>           | Test and record.  |
| # 46 | <b>Power and<br/>Tone of Muscles</b>   | Examine and record.   |
| # 47 | <b>Proprioception<br/>Stereognosis</b> | Examine and record.   |
| # 48 | <b>Romberg</b>                         | Do and record.  |

# 49	<b>Unterberger [Balance]</b>	Optional, if done record.
# 50	<b>Nystagmus</b>	Do and record.
# 51	<b>Sensations</b>	Test and record.
# 52	<b>Miscellaneous Remarks and Dermatome Diagram</b>	Record findings and comments.
# 53	<b>Urinalysis</b>	Includes color pH, specific gravity, glucose, albumin, micro and all results should be within normal limits.
# 54	<b>Blood Tests</b>	<ul style="list-style-type: none"> <li>a) Hematology. Any significant anemia or history of hemolytic disease must be evaluated. When due to a variant hemoglobin state, it shall be disqualifying.</li> <li>b) Serology/AIDS test done. If positive, cause for rejection until properly treated and cleared.</li> <li>c) All applicants for diving duty should have a sickle cell and AIDS test done and recorded.</li> </ul>
# 55	<b>Pulmonary Function</b>	<p>Pulmonary function tests:</p> <ul style="list-style-type: none"> <li>a) All divers must have periodic pulmonary function tests to establish Forced Expiratory Volume at one (1) second (FEV1) and Forced Vital Capacity (FVC) recording best of three measurements. Using CECA Standards.</li> <li>b) A FEV1/VC x 100 ratio of less than 75% requires additional specialized pulmonary function tests to determine suitability. The "1" means FEV in "one" second.</li> </ul>
# 56	<b>X-rays</b>	<ul style="list-style-type: none"> <li>a) 14 x 17 Chest - no pathology within normal limits.</li> <li>b) Lumbar sacral spine.</li> <li>c) Long bones - any lesions, especially juxta-articular, should be evaluated to determine patient's fitness to dive.</li> </ul>
# 57	<b>Electrocardiogram</b>	ECG examinations: all divers should have a resting standard 12 lead ECG at initial examination and annually after the age of 35.
# 58	<b>Audiogram Pure Tone</b>	A hearing loss in either ear of 35 dB or more at frequencies up to 3000 Hz and 50dB or more at frequencies above 3000 Hz to a minimum of 6000Hz is an indication for referral of the candidate to a specialist for further opinion, unless the examining doctor is convinced that such a hearing loss is unlikely to be significantly increased by continued diving activities. Doubts about function of labyrinths require specialized examination.



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| # 59 | <b>SMA - 12</b>    | Optional, if done record. |
| # 60 | <b>Drug Screen</b> | Do and record.            |

### 2.9.3 Psychiatric

The nature of diving duties requires a careful appraisal of the individual's emotional and temperamental fitness. Personality disorders, psychosis, immaturity, instability and anti-social traits shall be disqualifying. Severe stammering or stuttering shall disqualify. Any past or present evidence of psychiatric illness shall be cause for rejection unless the examining doctor can be confident that it is of a minor nature and unlikely to occur. Particular attention should be paid to any past or present evidence of alcohol or drug abuse. Any abnormalities should be noted in Block #52 of the physical examination form.

### 2.9.4 Temperament

The nature of diving duties requires a careful appraisal of the individual's emotional and temperamental fitness. Past or current symptoms of neuropsychiatric disorder or organic disease of the nervous system shall be disqualifying. No individual with a history of any form of epilepsy, or head injury with sequelae, or personality disorder shall be accepted. Neurotic trends, emotional adjustment, shall be disqualifying. Stammering or other speech impediment which might become manifest under excitement is disqualifying. Intelligence must be at least normal. Any abnormalities should be noted in Block #52 of the physical examination form.



## ASSOCIATION OF DIVING CONTRACTORS INTERNATIONAL MEDICAL HISTORY FORM

Company's Name _____			Date _____		
1. Last Name	First Name	Middle Name	2. Date of Birth	Sex	3. SSN or PASSPORT No.
4. Address (Number, Street, City, State, Zip Code)				5. Area Code/Telephone Number	
6. Position		7. Spouse Name		8. CHECK ONE ( ) Single ( ) Divorced ( ) Married ( ) Widowed	
9. No. Children		10. Next of Kin/Relationship/Address/Telephone Number			

11. My Present State of Health is: ( ) Excellent ( ) Good ( ) Fair ( ) Poor

12. MEDICAL HISTORY: Have you ever had or been treated for:

YES	NO		YES	NO		YES	NO	
_____	_____	Skin Rash	_____	_____	Abnormal Heart Rhythm	_____	_____	Rheumatism
_____	_____	Convulsions	_____	_____	Fainting	_____	_____	Back Strain
_____	_____	Epilepsy	_____	_____	Heart Disease	_____	_____	Dislocations
_____	_____	Head Injury	_____	_____	Asthma	_____	_____	Paralysis
_____	_____	Disabling Headaches	_____	_____	Coughing	_____	_____	Muscle Weakness
_____	_____	Nervous Breakdown	_____	_____	Tuberculosis	_____	_____	Knee Injury or "Trick Knee"
_____	_____	Uncorrectable Vision	_____	_____	Swindling or Deceit	_____	_____	Shoulder Injury
_____	_____	Color Vision Defect	_____	_____	Stomach Trouble	_____	_____	Arthritis
_____	_____	Eye Trouble (not glasses)	_____	_____	Cough	_____	_____	Broken Bones
_____	_____	Eye Surgery	_____	_____	Stomach Trouble	_____	_____	Spine Problems
_____	_____	Defective Hearing	_____	_____	Stomach Ulcer or Ulcers	_____	_____	Swollen Ankles
_____	_____	Ear Trouble	_____	_____	Jaundice	_____	_____	Foot Trouble
_____	_____	Perforated Eardrum	_____	_____	Kidney	_____	_____	Elbow Injury
_____	_____	High Fever	_____	_____	Liver Disease	_____	_____	Diabetes
_____	_____	Bleed	_____	_____	Appendicitis	_____	_____	Tumor or Cancer
_____	_____	Airway Obstruction	_____	_____	Stomach	_____	_____	Goiter or Thyroid Trouble
_____	_____	Chest Pain	_____	_____	Stomach	_____	_____	Blood Disease
_____	_____	Stomach	_____	_____	Stomach	_____	_____	Anemia: Sickle Cell or Other
_____	_____	Stomach	_____	_____	Stomach	_____	_____	Irregular Menses
_____	_____	Stomach	_____	_____	Stomach	_____	_____	Painful Menstrual Cycle
_____	_____	Stomach	_____	_____	Stomach	_____	_____	Pregnancy
_____	_____	Stomach	_____	_____	Stomach	_____	_____	Pneumothorax ("collapsed lung")
_____	_____	Stomach	_____	_____	Stomach	_____	_____	Any Sexually Transmitted Disease
_____	_____	Stomach	_____	_____	Stomach	_____	_____	Contagious Disease
_____	_____	Stomach	_____	_____	Stomach	_____	_____	Other Illness or Injury or Any Other Medical Condition

PLEASE EXPLAIN THE DETAILS OF ITEMS CHECKED YES: \_\_\_\_\_

13. LIST ALL SURGERIES, SERIOUS ILLNESSES, OR INJURIES: \_\_\_\_\_

YEAR \_\_\_\_\_

14. ANSWER THE FOLLOWING QUESTIONS:

Every Item Checked Yes Must Be Fully Explained Below	YES	NO		YES	NO
Do you have any physical defects or any partial disabilities?			Have you been advised to have a surgical operation or medical treatment that has not been done?		
Do you have any condition that may require special work assignment?			Have you ever resigned, been terminated, or changed jobs for medical reasons?		
Have you ever been rejected or rated for insurance, employment, license, or armed forces for health reasons?			Have you ever been dismissed from employment because of excess use of alcohol or drugs?		
Have you had significant exposure to mining dust, asbestos, silica, or toxic chemicals?			Do you presently use marijuana, LSD, narcotics, or any controlled substances?		
Have you ever had ill effects from any work that you have done?			Do you have any allergies or reactions to food, chemicals, drugs, insect stings, or marine life?		
Are you taking any type of medications including patient medicines?			Are you presently under the care of a physician? Give physician's name and address below.		

COMMENTS: \_\_\_\_\_



15. MY PERSONAL PHYSICIAN IS:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

16. HOW LONG HAVE YOU BEEN DIVING? \_\_\_\_\_

Max. Depth: Surface Air \_\_\_\_\_

Surface Mixed Gases \_\_\_\_\_

Longest Bottom Time: Air \_\_\_\_\_

Mixed Gas \_\_\_\_\_

HAVE YOU MADE ANY SATURATION DIVES? ( ) YES ( ) NO

Gas Mix: Heliox ☐

Trimix ☐

Nitrox ☐

Max. Depth \_\_\_\_\_

Total Duration (Days) \_\_\_\_\_

17. DIVING EXPERIENCE: (NUMBER OF YEARS EXPERIENCE) AIR \_\_\_\_\_ MIXED GASES \_\_\_\_\_ SATURATION \_\_\_\_\_

HAVE YOU PASSED AN OXYGEN TOLERANCE TEST? \_\_\_\_\_ NAME OF COMPANY/SCHOOL \_\_\_\_\_

18. NUMBER OF DECOMPRESSION INCIDENTS:

Bends: Pain Only \_\_\_\_\_ Neurological \_\_\_\_\_ Serious Symptoms: Chokes \_\_\_\_\_ Inner Ear \_\_\_\_\_

List any residuals: \_\_\_\_\_

19. IN DIVING HAVE YOU HAD A HISTORY OF: (Provide details of dates and severity)

Gas Embolism \_\_\_\_\_

Oxygen Toxicity \_\_\_\_\_

CO<sub>2</sub> Toxicity \_\_\_\_\_

CO Toxicity \_\_\_\_\_

Ear/Sinus Squeeze \_\_\_\_\_

Ear Drum Rupture \_\_\_\_\_

Deafness \_\_\_\_\_

Lung Damage \_\_\_\_\_

Inner Ear \_\_\_\_\_

Asphyxia \_\_\_\_\_

Loss of Consciousness \_\_\_\_\_

Thorax \_\_\_\_\_

Barocosis \_\_\_\_\_

Loss of Consciousness \_\_\_\_\_

20. Have you been involved in a diving accident (decompression sickness or others) since your last physical examination? \_\_\_\_\_

Date of last physical examination: \_\_\_\_\_

For what company or organization were you examined last? \_\_\_\_\_

Name and address of physician who performed your last examination. \_\_\_\_\_

21. Have you ever had any of the following? If so, give approximate date:

( ) Chest X-Ray \_\_\_\_\_

( ) Longbone Series \_\_\_\_\_

( ) Back (Spine) X-Ray \_\_\_\_\_

( ) ENG \_\_\_\_\_

( ) EEG \_\_\_\_\_

( ) EMG \_\_\_\_\_

( ) Nerve Condition Studies \_\_\_\_\_

( ) Pulmonary Function Studies \_\_\_\_\_

( ) Audiogram \_\_\_\_\_

( ) EKG \_\_\_\_\_

( ) Exercise EKG \_\_\_\_\_

( ) Treadmill EKG \_\_\_\_\_

22. Physician's Remarks: \_\_\_\_\_

I CERTIFY THAT I HAVE REVIEWED THE FOREGOING INFORMATION SUPPLIED BY ME AND THAT IT IS TRUE AND COMPLETE TO THE BEST OF MY KNOWLEDGE. I UNDERSTAND THAT LEAVING OUT OR MISREPRESENTING FACTS CALLED FOR ABOVE MAY BE CAUSE FOR REFUSAL OF EMPLOYMENT OR SEPARATION FROM THE COMPANY. I AUTHORIZE ANY OF THE DOCTORS, HOSPITALS, OR CLINICS MENTIONED ABOVE TO FURNISH THE COMPANY MEDICAL EXAMINER WITH A COMPLETE TRANSCRIPT OF MY MEDICAL RECORD FOR PURPOSES OF PROCESSING MY PHYSICAL EXAM.

DATE

NAME (print)



**ASSOCIATION OF DIVING CONTRACTORS INTERNATIONAL  
PHYSICAL EXAMINATION FORM**

Company's Name _____			Date of Examination _____		Date of Birth _____	
1. Last Name _____ First Name _____ Middle Name _____			2. SSN or PASSPORT No. _____			
3. Height (inches) _____		4. Weight _____	5. Temperature _____	6. Blood Pressure Right _____ Left _____	7. Pulse/Rhythm _____	
8. General Appearance/Hygiene _____		9. Nutrition _____		10. Build ( ) Slender ( ) Muscular ( ) Obese		
11. Distant Vision: Snellan R. 20/ _____ Corr. to 20/ _____ L. 20/ _____ Corr. to 20/ _____			12. Near Vision: Jaeger R. _____ % Corr. to _____ L. _____ % Corr. to _____			
13. Color Vision (Test and Results) _____		Field of Vision R. _____ % L. _____ %		Confrontation ( ) N		
Normal	Check each item in appropriate column (enter NE for Not Evaluating)				Abnormal	
	16. Head, Face, and Scalp					
	17. Neck					
	18. Eyes					
	19. Fundus					
	20. Ears - General (Int. and Ext. Canal)					
	21. Eustachian Tube Function					
	22. Drum Perforation					
	23. Nose (Septal Alignment)					
	24. Sinuses					
	25. Mouth and Throat					
	26. Lungs and Chest (Includes Breasts)					
	27. Heart (Thrust, Size, Rhythm, Sounds)					
	28. Pulses (Equality, etc.)					
	29. Vascular System (Vessels, etc.)					
	30. Abdomen and Pelvis					
	31. Hernia (All Types)					
	32. Endocrine System					
	33. Urinary System					
	34. Upper Extremities (Strength)					
	35. Lower Extremities (Strength)					
	36. Feet					
	37. Reflexes					
	38. Sensory					
	39. Coordination					
	40. Gait					
	41. Pelvic Exam					
<b>NEUROLOGICAL EXAMINATION</b>						
42. SENSORY _____						
43. CRANIAL NERVES						
I Olfactory _____			VII Facial _____			
II Optic _____			VIII Auditory _____			
III Oculomotor _____			IX Glossopharyngeal _____			
IV Trochlear _____			X Vagus _____			
V Trigeminal _____			XI Spinal Accessory _____			
VI Abducent _____			XII Hypoglossal _____			
44. REFLEXES: DEEP TENDON (Gradation of 4)						
		Right	Left			
		Triceps _____	_____			
		Biceps _____	_____			
		Patella _____	_____			
		Achilles _____	_____			
				PATHOLOGICAL		
		Right	Left			
		Babinski _____	_____			
		Hoffman _____	_____			
		Ankle Clonus _____	_____			
				SUPERFICIAL		
		Upper Abdomen _____				
		Lower Abdomen _____				
		Cremasteric _____				
45. CEREBELLAR FUNCTION						
		YES	NO			
		Ataxia _____	_____			
		Tremor (Intention) _____	_____			
		Finger to Nose _____	_____			
		Heel to Shin (Sliding) _____	_____			
46. POWER AND TONE OF MUSCLES						
		Right Upper Extremity _____				
		Left Upper Extremity _____				
		Right Lower Extremity _____				
		Left Lower Extremity _____				
47. PROPRIOCEPTION-STEREOGNOSIS						
		Right	Left			
		Joint Position Sense _____	_____			
		Astereognosis _____	_____			
		Vibratory Sensations _____	_____			
48. ROMBERG SIGN						
49. UNTERBURGER (If Performed)						
		Degrees	10 Sec. _____			
			20 Sec. _____			
			30 Sec. _____			
		Direction	R. _____ L. _____			
50. NYSTAGMUS						
		YES	NO			
		End Point _____	_____			
		Pathological _____	_____			
51. SENSATIONS						
		Hot _____	Cold _____			
		Sharp _____	Soft _____			
		Two Point Discrimination	NL _____ ABN _____			



52. Additional remarks regarding abnormal findings on physical

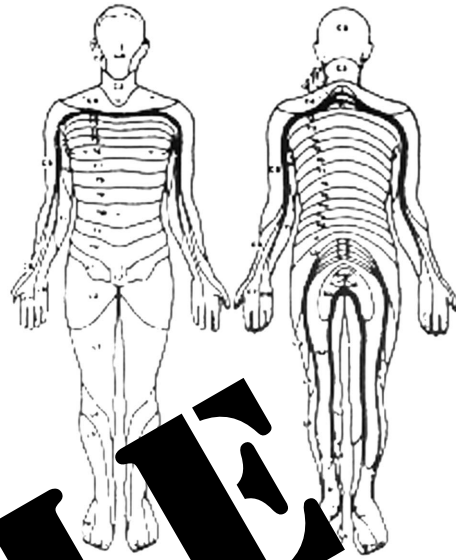


Diagram of the 100 of altered sensations, surgical scars and traumatic scars.

## LABORATORY FINDINGS

### 53. URINALYSIS

Color _____	Sugar _____
Appearance _____	Blood _____
Sp. Gravity _____	Ketones _____
pH _____	Bilirubin _____
Albumin _____	Urobilinogen _____
	Microscopic _____

## 54. BLOOD TESTS

CBC \_\_\_\_\_ Serology \_\_\_\_\_  
 \_\_\_\_\_ Test \_\_\_\_\_  
 Hct \_\_\_\_\_ Result \_\_\_\_\_  
 Hb \_\_\_\_\_  
 Blood Type and Rh \_\_\_\_\_  
 Sickie Cell Index \_\_\_\_\_  
 AIDS \_\_\_\_\_

## 55. PULMONARY FUNCTION

FVC \_\_\_\_\_  
 FEV<sub>1</sub> \_\_\_\_\_  
 FEV<sub>1</sub>/FVC \_\_\_\_\_

Chest (14 x 17) \_\_\_\_\_  
 Lumbosacral Spine \_\_\_\_\_  
 Long Bone Series \_\_\_\_\_  
 Other \_\_\_\_\_

## 57. ELECTROCARDIOGRAPHY

Static \_\_\_\_\_

Stress or Exercise \_\_\_\_\_

### 58. AUDIOGRAM PURE TONE

HZ	500	1000	2000	3000	4000	6000	8000
Right							
Left							

**59. SMA-12**

## Drug Screen

This examinee is: ☐ Fit for diving  
☐ Fit for employment  
☐ Unfit

This certificate is issued subject to condition(s) that:

☐ No restrictions

( ) Restrictions:

Summarize findings resulting in disqualification:

Date of Examination

Name of Examinee

Name and Address of Physician (Print/Type)

Signature of Physician

## SECTION 3.0

# COMMERCIAL DIVER, ROV PERSONNEL, AND DIVER MEDICAL TECHNICIAN CERTIFICATION





## 3.0 COMMERCIAL DIVER, ROV PERSONNEL, AND DIVER MEDICAL TECHNICIAN CERTIFICATION

### 3.1 GENERAL

#### 3.1.1 Requirement

Member companies of the Association of Diving Contractors International (ADCI) employ persons to perform as Commercial Divers, Life Support Technicians, ROV Pilot/Technicians and Diver Medical Technicians. These individuals must be properly trained in accordance with the current edition of the *ADCI Consensus Standards for Commercial Diving and Underwater Operations* and will then continue their path of career progression through on-the-job training and demonstrated field and leadership experience.

#### 3.1.2 Qualification

Diplomas issued by a civilian or military educational organization are for the purpose of attesting that an individual has received the necessary basic formal training to enter a vocational field. Such instruments should not be used to verify that the graduate has actually performed as a commercial diver, Diver Medical Technician, Life Support Technician, or ROV Pilot/Technician nor should they be taken at face value as qualifying an individual to actually perform as a Commercial Diver or Life Support Technician in those occupations without having received additional on-the-job training through field experience and actual demonstration of competency.

**Note: The U.S. Department of Labor (OSHA) considers an employer to be in compliance with the Code of Federal Regulations if documentation shows that the diver completed training to the appropriate level (i.e., surface-supplied air or surface-supplied mixed gas) at a commercial diving school within a particular state, a military school, federal school, or an Association of Commercial Diving Educators (ACDE) accredited school.**

**An employer is also in compliance when documented evidence attests to the training level of employed divers under the national consensus standard published by the American National Standards Institute (ANSI) and the Association of Commercial Diving Educators (ACDE); ANSI/ACDE-01-1998 American National Standard for Divers – Commercial Diver Training – Minimum Standard.**

**OSHA considers an employer to be in compliance with the diver training requirements of the Code of Federal Regulations for any employed diver with a valid “ADCI Commercial Diver Certification Card” for the appropriate training level.**

#### 3.1.3 Certification

Certification cards issued by recreational agencies are not recognized as qualifying an individual to perform commercial diving activities in the absence of additional formal commercial diving training from an accredited source.

### 3.2 SCOPE AND APPLICABILITY

ADCI Standard 10-1999 expands upon ADCI Standard 10-1997 to establish a program whereby properly trained Commercial Divers, Life Support Technicians, or ROV Pilot/Technicians can obtain a certification card that indicates their qualification and competency



level as defined in the *ADCI Consensus Standards for Commercial Diving and Underwater Operations*.

Certification cards issued under this program will be valid for a period of four years from date of issue. Cards can be obtained only by presentation of acceptable documentation that the individual for whom the card is requested has recorded evidence of having completed the requisite training and on-the-job experience necessary to support card issue at the appropriate level of classification.

This standard contains the following provisions:

- Implemented originally in 1999, this procedure has been changed to provide an opportunity for application to obtain reference certification based on training or experience gained. The first “grandfather” period expired on 1 February 2001, and the second expired on 30 June 2003. Thereafter, applications will be handled on a case-by-case basis. During these periods ADCI member companies could apply for and obtain certification cards for their personnel by submission of a notarized letter signed by a responsible company officer requesting that certification cards be issued to qualified personnel. It is the responsibility of the requesting company to ensure that all pertinent records are available to support a request for issue of any certification card at the competency level requested and to make such records available should an audit be requested.

**FOR REFERENCE PURPOSES THE FULL TEXT OF THE CHANGES WAS:**

**Change 1.** Effective on 1 July 2002, an additional grandfather period shall be implemented for the Latin American & Caribbean Chapter, and for the Asia Pacific Chapter. This grandfather period shall expire on 30 June 2003. Additionally, a one-year grandfather period shall be implemented for any new international chapter accepted for membership in ADCI, to cease one year from date of acceptance. In the case of international chapters, each chapter shall establish a mechanism whereby they shall appoint individuals to actively assist ADCI to determine whether a certification card application from a member within their chapter is supported by all necessary documentation to reflect the prior training and actual field experience of the individual for whom the application is tendered. In the case of applications received from non-member companies, each chapter shall establish a procedure to verify facts regarding reported training, field experience, and competency.

**Change 2.** Effective on 15 October 2002, an additional grandfather period shall be implemented to reconcile the fact that many active commercial divers throughout the U.S. and other nations have received training of an on-the-job nature. This additional grandfather period will expire on 30 June 2003. Following that date each application will be handled in a case-to-case manner based upon submitted documentation. Accordingly, the on-the-job experience of persons with a minimum of five years of documented activity performing commercial diving operations will be eligible to submit an application for certification if in all other respects they are in compliance with the requirements of this standard. Personnel who fall into this category will be required to document their experience by furnishing complete and verifiable Diver Logbook entries; or in the alternative, complete and verifiable company records that completely and adequately show a minimum of five years of on-the-job experience plus a record of all training having been received prior to and during that period.

**Change 3.** Implemented by this publication, incorporates into the process the certification levels of:

ROV Supervisor  
Senior ROV Pilot/Technician  
ROV Pilot/Technician  
Entry-Level ROV Pilot/Technician/Diver Medical Technician

- After 1 February 2001 the full documentation requirements of this standard came into force. Issue of certification cards, in addition to the procedures set forth above, required that a Company Officer attest to the fact that the individual for whom the diver's certification card was sought had completed each of the qualification steps set forth under "Card Description" and that a valid Diver's Logbook was available wherein these steps were recorded in a suitable check-off list endorsed by the signature of a responsible Diving Supervisor or Company Officer.
- In all cases it shall be the responsibility of the employer to assure that the bearer of any ADCI Commercial Diver, Life Support Technician, Diver Medical Technician or ROV Pilot/Technician Certification Card is properly qualified to perform the duties of the level noted thereon. ADCI shall make every reasonable effort to verify information furnished to assure that no cards are issued to personnel who have not, in fact, completed the requisite training, on-the-job performance, and necessary number of dives/hours of activity. However, it must be realized that in making such a determination that ADCI shall be relying upon information provided that is believed to have derived from a legitimate source and as such, shall bear no responsibility for the lack of any individual to perform duties as may be expected.
- Employment of an individual bearer of an ADCI Certification Card at any level is the right and responsibility of the employing company. ADCI shall prepare and furnish to member companies various sets of guidance questionnaires that may be used to evaluate the knowledge of supervisory personnel in each of the certification areas (Air, Mixed Gas, Bell/Sat, ROV). It is recommended that employing companies utilize these questionnaires and, where appropriate, expand upon the list of questions as may be appropriate and desirable.

### 3.3 CERTIFICATION CARD DESCRIPTIONS

#### 1. **Entry-Level Tender/Diver - Entry Level Diver Medical Technician/Diver:**

This card will be issued by the ADCI at no cost to all graduates of ADCI member schools who complete a commercial diver training-program consisting of a minimum of 317 hours of formal instruction in accordance with the provisions of the *ADCI Consensus Standards for Commercial Diving and Underwater Operations* including reference to the American National Standard for Divers (ANSI) Secretariat of the Association of Commercial Diving Educators (ACDE).

All ADCI Commercial Diver, Diver Medical Technician/Diver and Life Support Technician Certification Cards will be issued to qualified personnel (less those in Paragraph 1 above) at a cost of \$25.00 USD per card and in accordance with procedures set forth hereafter under "Documentation Accepted." This fee must accompany the application form.

Graduates of formal commercial diving schools not members of ADCI may apply to receive this type of certification card at a cost of \$25.00 USD per card by presenting evidence that they have attended a recognized course of formal instruction consistent with the provisions of the *ADCI Consensus Standards for Commercial Diving and Underwater Operations* including reference to the American National Standard for Divers (ANSI) Secretariat of the Association of Commercial Diving Educators (ACDE).

#### 2. **Entry-Level Medical Technician/Diver**

This type of card will be issued by ADC International to graduates of accredited schools or member company training programs intended to furnish the entry-level individual with not less than 317 hours of formal instruction in diving related matters as set forth in this Standard and ANSI/ACDE 01-1998 plus a further 45 hours of formal training and 35 hours of Supervised Practicums.



### 3. Entry-Level ROV Pilot/Technician

This type of card will be issued by ADC International to graduates of accredited schools or member company training programs intended to furnish the entry-level individual with not less than 320 hours of formal instruction. Of that formal instruction, credit may be given for recognized courses in hydraulics, electronics, electrical, or other courses appropriate for the education required of such personnel.

### 4. Surface-supplied Air Diver

This type of card will be issued by ADC International to applicants who have:

- a. Completed a formal course of instruction at a recognized commercial diving school, military training, or equivalent consisting of at least 317 hours of instruction.
- b. Completed at least an additional 308 hours of documented on-the-job training as set forth in the *ADCI Consensus Standards for Commercial Diving and Underwater Operations* unless earlier completed as a portion of formal training at an accredited commercial diving school, military dive school, or equivalent.
- c. Completed at least 100 field days participating in commercial diving operations.
- d. Completed at least 30 working dives.

### 5. ROV Pilot/Technician

This type of card will be issued by ADC International to applicants who have:

- a. Completed a formal course of instruction as noted above,
- b. Performed not less than 150 field days participating in ROV operations, and
- c. Completed 60 piloting hours on either Class I, II, IV, or V ROV's.

**Note: If Class IV and/or Class V; these would be for Class I or Class II ROV's suitably adapted to that class.**

- d. Performed not less than 150 field days and 100 piloting hours on either Class III, IV, or V ROV's.

### 6. Surface-Supplied Air Diving Supervisor

This type of card will be issued by ADC International to certified Air Divers who have:

- a. Completed an additional 100 field days participating in commercial diving operations during which they shall have:
  - Performed at least 50 working dives and performed a minimum of 30 days as an Assistant Surface-Supplied Air Diving Supervisor.

### 7. Mixed-Gas Diver

This type of card will be issued by ADC International to certified Air Divers who have:

- a. Completed at least 100 field days as an Air Diver,
- b. Completed at least 50 working dives as an Air Diver, and
- c. Completed at least 50 field days participating in surface mixed-gas diving operations during which they shall have:
  - Performed at least 10 working mixed-gas dives.

### 8. Senior ROV Pilot/Technician

This type of card will be issued by ADC International to ROV Pilot/Technicians who have:

- a. Achieved the status of ROV Pilot/Technician,
- b. Completed a total of 300 field days participating in ROV operations, and
- c. Completed at least 60 piloting hours (if Class I, II, IV, or V – with Classes IV or V on Class I or II vehicles); or completed at least 100 piloting hours (if Class III, IV, or V).

### 9. Mixed-Gas Diving Supervisor

This type of card will be issued by ADC International to certified Mixed Gas Divers who have:



- a. Completed at least 350 field days as an Air or Mixed-Gas Diver,
- b. Completed at least 150 working dives as an Air or Mixed-Gas Diver, and
- c. Completed at least 30 working days as an Assistant Mixed-Gas Diving Supervisor.
- d. Individual is also qualified to work as an Air Diving Supervisor.

10. **Bell/Saturation Diver**

This type of card will be issued by ADC International to certified divers who have:

- a. Completed at least 200 field days as an Air or Mixed-Gas Diver,
- b. Completed at least 100 working dives as an Air or Mixed-Gas Diver, and
- c. Performed for at least 30 working days in support of Bell/Saturation Diving operations.

11. **Bell/Saturation Diving Supervisor**

This type of card will be issued by ADC International to certified divers who have:

- a. Completed at least 100 field days as a Mixed-Gas Diving Supervisor, and
- b. Performed for at least 60 days as an Assistant Bell/Saturation Diving Supervisor.

12. **ROV Supervisor**

This type of card will be issued by ADC International to certified ROV Senior Pilot/Technicians who have completed 150 field days as an ROV Senior Pilot/Technician and 60 piloting hours on their assigned class of ROV.

13. **Life Support Technician**

This type of card will be issued by ADC International to personnel who have:

- a. Performed at least 100 field days as an assistant Life Support Technician.

**Note: It is preferred but not mandatory that this individual shall have been previously certified to at least the level of an Air Diver.**

14. **Non-Diving Supervisor**

This type of card will be issued by ADC International to personnel who have:

- a. Previously been qualified as a Diving Supervisor (Air, Mixed Gas, Bell/Sat) within the category achieved as set forth in the preceding portions of this standard. Non-Diving Supervisors cards will be issued only to persons who have been continually active in the commercial diving industry without a "lapse" from participation for a period of one year prior to request for issue. Renewal of such a card shall be made to personnel who have performed in the Non-Diving Supervisor role during at least three of the four years of prior certification card validity.

15. **Diver Medical Technician**

This type of card will be issued by ADC International upon receipt of confirmation from an acknowledged accreditation agency that the individual for whom the application is submitted has completed all necessary prerequisites. Any training agency making such submission must be recognized by ADC International as a member company in good standing.

### 3.4 DOCUMENTATION ACCEPTED

1. ADC International certification cards may be requested by ADCI member companies by certifying that the person for whom the card is requested fully qualifies to perform duties in the diver or ROV classification requested. Member companies are required to have on file, and to retain for a period of four years, copies of information that show evidence that the individual for whom the card is requested does, in fact, possess the necessary training, field experience, and required number of working dives or piloting hours.



2. Personnel are required to properly maintain a Commercial Diver's Logbook, or ROV Logbook as appropriate.
3. Individual personnel seeking to obtain an ADC International certification card (other than Entry-Level Tender/Diver) are required to have verifiable evidence in the forms necessary to support the application and will, in the case of the Diving Supervisor or ROV Supervisor levels, be required to obtain and provide verifiable endorsements from ADCI or IMCA member companies for whom they shall have records of performance as an Assistant Diving Supervisor or Diving Supervisor.
4. ADC International member companies resident outside of the United States must obtain an endorsement from another ADCI member company or from an IMCA member company for applications for certification cards for personnel in their employ. This endorsement can be in the form of a letter or other document that verifies that the ADCI member or IMCA member has worked with or employed personnel, or observed that operations of the non-resident company member are in full compliance with the ADCI or IMCA minimum Standards/Codes.
5. **ADCI Member Commercial Diving, ROV Pilot/Technician or Diver Medical Technician Schools**  
Application for the Entry-Level Certification Cards may be made by filing with ADCI a listing of the members of each class together with their social security number or other identifying number, their date of birth, and a photograph meeting the requirements of this standard. Certification cards will be prepared for each individual identified and returned to the requestor. The cards may be issued ONLY to individuals who actually graduate. Any card furnished to the school for issue to an individual who DOES NOT graduate will be returned to ADCI for disposal and removal of information from the master database.
6. **Non-ADCI Member Commercial or Government/Military Diving Schools**  
Application for Entry-Level Certification Cards for non-ADCI member commercial diving schools will be accepted under the following provisions:
  - a. That they be formally recognized as an accredited school by a government body.
  - b. That the course of instruction offered generally parallels that of the Association of Commercial Diving Educators as recognized in the *ADCI Consensus Standards for Commercial Diving and Underwater Operations* to comprise not less than 317 hours of formal instruction in the subjects set forth therein or, as appropriate, the contents of this standard addressed to training and education.
  - c. That the course of instruction offered will in all cases parallel that established in the American National Standards Institute document ANSI/ACDE-01-1998; the Secretariat, the Association of Commercial Diving Educators (ACDE) or formal procedures recognized by this association and consideration to be at least equal to the procedures necessary for application by a member company of ADC International.
  - d. That the application for issue of an ADC International Entry-Level Tender/Diver Certification Card will require the payment of a \$25.00 USD fee for each card that must accompany the request application.

**In all cases a completed Diver's, ROV Pilots/Technician, or Diver Medical Technician Logbook will be a requirement of the application process with entries therein properly attested to by signature of a responsible Company Officer or Diving Supervisor.**

### 3.5 CARD ISSUE

The ADC International Commercial Diver (or other appropriate) Certification Card will be a 2 1/8 x 3 3/8, .030" thick plastic laminated card suitably identified as issued by the Association of Diving Contractors International. Cards will be sequentially numbered from 000001 and prepared (color passport photo is required). In the event that a color photo cannot be furnished a black and white will be considered acceptable.

A photograph of the bearer will be laser scanned onto the card and the card itself protected from being changed or counterfeited by fixing of a holographic overlay onto the card prior to top coating with a Duraguard™ finish.

With the exception of Entry-Level Certification Cards that shall be issued to graduating students of ADC International member schools, an appropriate fee will be charged to cover the cost of the card to include handling and postage. This sum is identified on the application form and must be paid at the time of application.

### 3.6 DATABASE MAINTENANCE

The Association of Diving Contractors International will maintain a database of certified card recipients based upon card issue. That data base will contain the sequential number for each card, the name and social security (or other identifier such as passport number), the date of birth, the date of issue, and the expiration date for all cards issued.

The database will be maintained **confidential** and not released to any party. Its existence will be used as a verification tool for replacement of lost cards, renewal of cards, and as a means of generally tracking the numbers of certified commercial divers within industry.

The format and content of the database will not be released or changed without ADCI Board of Directors approval.



## 3.7

### COMMERCIAL DIVER AND LIFE SUPPORT TECHNICIAN CERTIFICATION CARD REQUIREMENTS

<i>Requirement</i>	<i>Entry Level Tender/Diver</i>	<i>Air Diver</i>	<i>Air Diving Supervisor</i>	<i>Mixed Gas Diver</i>	<i>Mixed Gas Diving Supervisor</i>	<i>Bell/Sat Diver</i>	<i>Bell/Sat Diving Supervisor</i>	<i>Life Support Technician</i>
<b>Formal Training</b>	317 hours	317 hours						
<b>On the Job Training</b>		308 hours	Note: If this training has been received as a portion of formal training at an accredited commercial diving school, military dive school, or equivalent it need not be repeated.					100 Working Days
<b>Field days</b>		100	200	100 Air 50 Mixed Gas	350 Air or Mixed Gas Diver	200 Air or Mixed Gas	100 as Mixed-Gas Diving Supervisor	
<b>Working Dives</b>		30	50	50 - Air 10 - Mixed Gas	150 Air or Mixed Gas	100 Air or Mixed Gas		
<b>Operations on System</b>						30 Working Days		
<b>Assistant Supervisor Training</b>			30 Working Days		30 Working Days		60 Working Days	

- NOTES:
- (1) Formal training in accordance with ADC Consensus Standards
  - (2) On the Job training in accordance with ADC Consensus Standards
  - (3) Field Days - Inland/Coastal = 8 hours // Offshore = 12 hours

## 3.8

### ROV PILOT/TECHNICIAN AND ROV SUPERVISOR CERTIFICATION CARD REQUIREMENTS

<i>Requirement</i>	<i>Entry Level ROV Pilot/Technician ROV</i>	<i>Pilot/Technician</i>		<i>ROV Senior Pilot/Technician</i>	<i>ROV Supervisor</i>
<b>Formal Training</b>	320 hours				
<b>Field days</b>		150		300	150
<b>Pilot Hours</b>		60 100 60/100	Class I, II Class III Classes IV, V	60 Class I, II 100 Class III 60/100 Classes IV, V	60 All Classes



## 3.9 COMMERCIAL DIVER CERTIFICATION CARD (ADCI MEMBER)

ADCI  
5206 FM 1960 West, Suite 202  
Houston, TX 77069

New Application ☐Renewal ☐

## COMMERCIAL DIVER CERTIFICATION CARD APPLICATION

Entry-Level Tender/Diver

Application from ADCI Member Commercial Diving School

I do hereby apply for the issue of ADCI Commercial Diver Certification Card for the following Entry-Level Tender/Diver's who are members of Class \_\_\_\_\_ scheduled to graduate on \_\_\_\_\_ : (Use separate sheet to record your information)

Name	Social Security Number or other Identifying Number	Date of Birth	Photograph #	Fee Included [\$25.00 USD]

In making this application I understand and acknowledge that the Association of Diving Contractors International is relying upon my statement that the individual(s) for whom card issue is requested has met the training and experience criteria of the ADCI Consensus Standards for Commercial Diving Operations; that each graduate will have received at least a minimum of 317 formal classroom and training hours in the subject material identified therein, and that the provisions of ADCI Standard 10-1999 have been met. By such action I specifically release the Association of Diving Contractors International from any and all liability which may extend to the issue and use of the requested card(s) to the individual(s) identified above.

&gt; \_\_\_\_\_

\_\_\_\_\_  
Printed Name\_\_\_\_\_  
Commercial Diving School

Accredited in accordance with the Laws of: \_\_\_\_\_

\_\_\_\_\_  
Signature\_\_\_\_\_  
Date



## 3.10 COMMERCIAL DIVER CERTIFICATION CARD APPLICATION (Non-ADCI MEMBER)

ADCI  
5206 FM 1960 West, Suite 202  
Houston, TX 77069

New Application ☐

Renewal ☐

### COMMERCIAL DIVER CERTIFICATION CARD APPLICATION

Entry-Level Tender/Diver

Application from Non-ADCI Member Commercial Diving School

I do hereby apply for the issue of ADCI Commercial Diver Certification Card for the following Entry-Level Tender/Diver's who are members of Class \_\_\_\_\_ scheduled to graduate on \_\_\_\_\_: (Use separate sheet to record your information)

Name	Social Security Number or other Identifying Number	Date of Birth	Photograph #	Fee Included [\$25.00 USD]

In making this application I understand and acknowledge that the Association of Diving Contractors International is relying upon my statement that the individual(s) for whom card issue is requested has met the training and experience criteria of the ADCI Consensus Standards for Commercial Diving Operations; that each graduate will have received at least a minimum of 317 formal classroom and training hours in the subject material identified therein, and that the provisions of ADCI Standard 10-1999 have been met. By such action I specifically release the Association of Diving Contractors International from any and all liability which may extend to the issue and use of the requested card(s) to the individual(s) identified above.

> \_\_\_\_\_

\_\_\_\_\_  
Printed Name

\_\_\_\_\_  
Commercial Diving School

Accredited in accordance with the Laws of: \_\_\_\_\_

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date



Date \_\_\_\_\_



## 3.12 COMMERCIAL DIVER CERTIFICATION CARD INDIVIDUAL APPLICATION

ADCI  
5206 FM 1960 West, Suite 202  
Houston, TX 77069

New Application ☐

Renewal ☐

### COMMERCIAL DIVER CERTIFICATION CARD APPLICATION

#### Individual Application

Name	Social Security Number or other Identifying Number	<b>Classification (select one)</b> Entry-Level Tender/Diver Air Diver Air Diving Supervisor Mixed Gas Diver Mixed Gas Diving Supervisor Bell/Sat Diver Bell/Sat Supervisor Life Support Technician	<b>Fee Included</b> [\$25.00 USD]

Address: \_\_\_\_\_

City, State/Province, Country, Postal Code \_\_\_\_\_

In making this application I understand and acknowledge that the Association of Diving Contractors International is relying in full upon my statement that the individual for whom card issue is requested is fully qualified to receive same by having met the training and experience criteria of the ADCI Consensus Standards for Commercial Diving Operations, Section 2.0 By such action I specifically release the Association of Diving Contractors International from any and all liability which may extend to the issue and use of the requested card to the individual identified above.

I further understand that validity of the requested Commercial Diver Certification Card is for a four (4) year period and at the expiration of the same a new card may be applied for if so desired.

To support the validity of this request for a Commercial Diver Certification Card I offer the following evidence that I am fully qualified to bear and display such a card:

1. Copies of my Divers Log Book for a period \_\_\_\_\_ 19\_\_\_\_ through \_\_\_\_\_ 20\_\_\_\_.
2. A copy of my diploma of certificate of course completion from \_\_\_\_\_.
3. A listing of all commercial diving companies for whom I have worked: [Use separate sheet if necessary.]

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Printed name: \_\_\_\_\_ Date: \_\_\_\_\_

\_\_\_\_\_  
Signature



### 3.13 PHOTO INSTRUCTIONS FOR COMMERCIAL DIVER CERTIFICATION CARDS

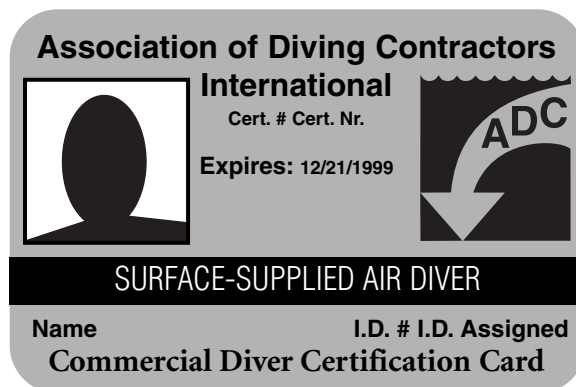
1. Take photograph against a light background color.
2. Photo should be taken of subject with full face view from a distance of approximately four (4) feet from the camera lens.
3. Full color photograph is required.
4. Identify photograph by writing subjects name below their photo on the bottom margin
5. If possible, use Polaroid 600 film.
6. Do not apply a paper clip directly to the face of the photograph.

Please remember that the photo will be trimmed to 1.25 inches in height and 1.0 inches wide. Ensure that our submitted photograph is consistent with the ability to have that size photograph laser scanned onto the certification card.

#### FRONTSIDE



Entry Level Tender/Diver



Surface-Supplied Air Diver



Mixed Gas Diver



Bell/Saturation Diver

#### BACKSIDE

The Association of Diving Contractors International (ADC) issues this Certification Card to the bearer relying only upon statements or information received that the named individual has completed all training, field experience, and necessary on-the-job performance to warrant identification as a Commercial Diver or Life Support Technician at the level of experience stated hereon. ADCI accepts no responsibility or liability for the failure of the bearer to perform his or her duties at any stated level of ability.

Additional specialized training and/or qualifications gained while engaged in the practice of commercial diving are as recorded in his or her company maintained personnel records and appropriate Diver's Log Books.

At a minimum, all commercial diving operations must be undertaken with minimum or a three man diving team in accordance with Consensus Standards for Commercial Diving Operations, (current edition).

Questions should be directed to ADCI at (281) 893-8388, Fax (281) 893-5118 or via email at [www.adci-int.org](http://www.adci-int.org).



## FRONTSIDE



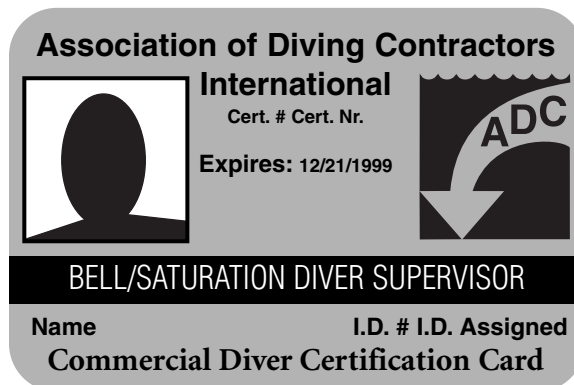
Life Support Technician



Surface-Supplied Air Diving Supervisor



Mixed Gas Diving Supervisor



Bell/Saturation Diver Supervisor

## BACKSIDE

The Association of Diving Contractors International (ADC International) issues this Certification Card to the bearer relying only upon statements or information received that the named individual has completed all training, field experience, and necessary on-the-job performance to warrant identification as a Commercial Diver or Life Support Technician at the level of experience stated hereon. ADC International accepts no responsibility or liability for the failure of the bearer to perform his or her duties at any stated level of ability.

Additional specialized training and/or qualifications gained while engaged in the practice of commercial diving are as recorded in his or her company maintained personnel records and appropriate Diver's Log Books.

At a minimum, all commercial diving operations must be undertaken with minimum or a three man diving team in accordance with Consensus Standards for Commercial Diving Operations, (current edition).

Questions should be directed to ADC International at (281) 893-8388, Fax (281) 893-5118 or via email at [www.adc-int.org](http://www.adc-int.org).



## SECTION 4.0

# OPERATIONS PROCEDURES





## 4.0 OPERATIONS PROCEDURES

### 4.1 SAFE PRACTICES/OPERATIONS MANUAL

1. Each employer shall develop and maintain a Safe Practices/Operations Manual as required by applicable government regulations and shall make this manual available at the dive location to each dive team member. This manual must provide for the safety and health of the divers. The Safe Practices/Operations Manual shall meet or exceed the requirements of the *ADCI Consensus Standards for Commercial Diving and Underwater Operations*.
2. The *ADCI Consensus Standards for Commercial Diving and Underwater Operations* may be used as a set of minimum guidelines to assist companies in developing their own specific Safe Practices/Operations Manual. Each employer is responsible for completing, modifying, and/or complementing any of the procedures, checklists, and standards in accordance with applicable governmental regulations and as dictated by specific policies and practices of the employer.

**In all cases the higher standard established by national regulations, requirements determined by the conduct of a Job Safety Analysis, or specific requirements of the contractual condition shall apply to the conduct of any commercial diving or underwater operation.**

3. The Safe Practices/Operations Manual shall, as a minimum, contain the following information:
  - a. A copy of applicable government regulations for the conduct of commercial diving or other underwater operations.
  - b. For each diving mode engaged in:
    - i. Safety procedures and checklists for commercial diving operations.
    - ii. Assignments and responsibilities of dive team members.
    - iii. Equipment procedures and checklists.
    - iv. Emergency procedures for fire, equipment failure, adverse environmental conditions, medical injury, and illness.
4. The Association of Diving Contractors International strongly recommends that each Safe Practices/Operations Manual contain a definitive statement regarding the use of drugs or alcohol. The statement should make reference to whatever national regulations or legislation furnishes requirements or guidance on testing of personnel (either prior to employment or while employed) and additionally addresses the employer's policy of drug awareness, rehabilitation, or penalties associated with the unauthorized use of drugs or alcohol.

### 4.2 EMERGENCY AID

1. Each employer shall develop and maintain a list of the available sources of emergency aid, equipment, and professional assistance with call signs, phone numbers, or other means and instructions for establishing contact with them.
2. Each contractor shall make the contact list available at the company's principal place of business, at the field operations office, and to those who may have a need for it to fulfill the company's emergency response plan.



3. The list shall include information necessary to obtain the following types of emergency aid as appropriate for the type of diving or underwater activity conducted:
  - Decompression chamber
  - Hospital or medical treatment facility
  - Air or ground transportation
  - On-call physician
  - Coast Guard or other National Rescue Coordination Centers
4. Two-way communications shall be available and accessible at any diving, hyperbaric, or other underwater work site in order to engage emergency services as required.

## 4.3 FIRST AID

1. First aid supplies appropriate for the type of operation being conducted shall be provided and kept readily accessible in a clearly marked container at the work site.
2. In addition to any other first aid supplies, an American Red Cross standard first aid handbook (or equivalent) and a bag-type manual resuscitator (or equivalent device) with transparent mask and tubing shall be available at the dive location.
3. A recommended list of the contents for a first aid kit, including a form for recurring inventory, is set forth below to reflect what should be considered the minimum contents. Each operator should review this list and make additions or substitutions as necessary to ensure that effective and timely first aid can be furnished.

### First Aid Kit Checklist/Inventory

- 100 "Band-Aid" Strips – Assorted
- 1 Triangular Bandage
- 1 Roll Adhesive Tape
- 2 Ammonia Inhalants
- 1 Package Absorbent Cotton
- 1 Bottle Eye Wash
- 1 Gauze Bandage, 1" x 10 Yds.
- 20 Aspirin Tablets
- 1 Gauze Bandage, 2" x 10 Yds.
- 4 Antiseptic Wipes
- 1 Elastic Bandage, 3" x 5 Yds.
- 1 Pair of Scissors
- 10 Non-Adherent Pads 2" x 3"
- 6 Pair Latex Examination Gloves
- 4 Oval Eye Patches
- 1 Cold Pack
- 1 Gel Pack, Burn Dressing Kit
- 1 Tourniquet
- 1 Rescue Airway
- 1 Pair of Tweezers
- 1 Trauma Dressing 8" x 10"
- 1 First Aid Booklet
- 2 One-way CPR Shields
- 1 Contents Card (inventory)
- 1 First Aid Cream
- 1 Waterproof Case

- 1 1-1/2 oz Tube, Triple Antibiotic
- 4 Biohazard Bags
- 1 Bag-type manual resuscitator with transparent mask & tubing

The following items are also recommended when operations are conducted at a remote site:

- 1 Bottle Oral Analgesic
- 1 Package “Alka Seltzer Plus”
- 1 Tube “Benadryl” Cream
- 1 Bottle Antacid Tablets
- 1 Tube “Neosporin” Ophthalmic Ointment
- 1 Basic Poison Antidote Kite
- 1 Bottle Insect Repellent
- 1 Bottle “Immodium AD”
- 1 Bottle “Sudafed” Tablets
- 1 Bottle/Tube Sunscreen 15+SPF
- 1 Bottle “Robitussin DM” cough syrup
- 1 Bottle Nasal Spray
- 1 Bottle Ear Drops

## 4.4 PLANNING AND ASSESSMENT

The planning of a diving or underwater operation shall include a Job Safety Analysis (see **Page 4-11**) of the safety and health aspects of the following:

- Diving mode
- Surface and underwater conditions and hazards
- Breathing gas supply (including reserves)
- Thermal protection
- Diving equipment and systems
- Dive team assignments and physical fitness of dive team members including any conditions which may render an individual dive team member unfit to dive. Competency of assigned personnel to perform necessary tasks and responsibilities.
- Repetitive dive designation or residual inert gas status of dive team members
- Decompression and treatment procedures (including altitude corrections)
- Emergency procedures

## 4.5 TEAM BRIEFING

1. Before commencing with any underwater operation, the dive or ROV team members shall be briefed on:
  - The tasks to be undertaken
  - Safety procedures for the diving mode
  - Any unusual hazards or environmental conditions likely to affect the safety of the underwater operation
  - Any modifications to operating procedures necessitated by the specific underwater operation
2. Before each dive the diver shall be instructed to report and record any physical conditions, problems, or adverse physiological effects that may render the diver unfit to dive.



## 4.6 TERMINATION OF DIVE

The working interval of a dive shall be terminated when:

- Directed by the Dive Supervisor and/or the Person in Charge
- The diver requests termination
- The diver fails to respond correctly to communications or signals from a dive team member
- Communications are lost and cannot be quickly reestablished between the diver, the Tender/Diver, the Diving Supervisor, and, in liveboating operations, the person controlling the vessel
- The diver begins to use the diver-carried reserve breathing gas or the dive-location reserve breathing gas

## 4.7 POST-DIVE PROCEDURES

1. After the completion of each dive the diver shall:
  - Be questioned as to his physical condition
  - Be instructed to report any physical problems or adverse physiological effects including symptoms of decompression sickness or gas embolism
  - Be advised of the location of an operational decompression chamber
  - Be alerted to the potential hazards of flying after diving
  - When diving, be alerted to the potential hazards of traveling to higher elevations from the dive site
2. After the completion of any dive outside the no-decompression time/depth limits, the following are recommended:
  - Take reasonable steps to have the diver remain awake and in the vicinity of the decompression chamber for at least one hour
  - Instruct such divers to remain within two hours' travel time of the decompression chamber for an additional five hours
  - Instruct such divers of the hazards of flying at altitudes in excess of 800 ft, except in an emergency within:
    - 12 hours after decompression from a non-saturation dive
    - 24 hours after decompression from a HeO<sub>2</sub> saturation dive
3. On any dive that results in decompression sickness, proper medical authority should be consulted prior to flying after treatment.

## 4.8 HAZARDS TO UNDERWATER OPERATIONS

1. Notice shall be given of the planned underwater operations, including the daily start and finish times, to those in the vicinity whose activities may interfere with or pose a hazard to personnel engaged in the operation. These activities include underwater demolition, movement of surface vessels, lifting of material directly over the underwater operations, etc.
2. Diving operations shall not take place wherever hazardous activities or conditions in the vicinity pose a safety hazard to the divers or impair the support personnel from safely carrying out their work tasks.
3. In no case shall the diver be required to dive against his will.



## 4.9 UNDERWATER HAZARDOUS CONDITIONS

Before any underwater task, a Job Safety Analysis (JSA) shall be performed (see Page 4-11).

The purpose of this analysis will be to determine underwater hazards, including but not limited to:

- Potential for fouling or entrapment of the diver or of the ROV.
- Differential pressure hazards, including but not limited to:
  - Underwater discharges, dredging, major intakes, pumps, sluices, suction, or valve culverts
  - Any activity that would expose the diver or ROV to differential pressure
- Lockout/tagout of hazardous energy situations, including but not limited to:
  - Active cathodic protection, high intensity sonars, propellers, pumps, vessels, or any mechanical apparatus whose inadvertent operation would be hazardous to the diver
  - All such devices shall be deactivated and their controls tagged prior to the commencement of the underwater operation.
- Diving in contaminated liquid, including but not limited to:
  - Chemical, microbiological, or radiological contamination
  - Any thermal or toxic threat to the diver
- Limited access or penetration situations. A diver entering a pipe, tunnel, wreck, or similarly enclosed or confining structure, (other than a habitat), shall:
  - Have an underwater Tender/Diver at the point of entry
  - Be equipped with an appropriate diver-carried reserve gas breathing supply
- Operations involving explosives

## 4.10 TEMPORARY IMPAIRMENT OR CONDITION

Divers shall not dive or be otherwise exposed to hyperbaric conditions for the duration of any known temporary impairment or condition, if such is likely to adversely affect health or interfere materially with the person's ability to safely perform a specific diving task or safely be exposed to hyperbaric conditions. These include but are not limited to colds, alcoholic intoxication or its aftereffects, influence of drugs, pregnancy, respiratory or middle ear diseases, skin or external ear infections, excessive fatigue, or emotional distress. The diver should be consulted before making such determination. In no case shall the diver be required to dive or be exposed to hyperbaric conditions against his will, except for treatment procedures.

## 4.11 INSPECTION OF SYSTEMS, EQUIPMENT, AND TOOLS

1. Before diving or other underwater operations commence, personnel shall confirm that all operational systems, equipment, and tools to be used are in working order, appropriate for the tasks and are in compliance with the **Section 5.0, "Equipment and Systems"** (pages 5-1 thru 5-18).
  - To ensure the highest standard of safety, checklists shall be used to confirm that the systems, equipment, and tools are in safe working order.
2. Operational systems, equipment, and tools used in underwater operations shall be inspected daily and monitored throughout the operations by designated persons.
3. Each person engaged as a diver in the diving operation shall inspect his personal diving equipment and confirm its operational readiness prior to each use. The Diving Supervisor or his designated alternate shall be likewise required to check the equipment of each diver before they enter the water.



## 4.12 ENTERING AND LEAVING THE WATER

There shall be a safe means for entering or leaving the water from the diving platform, such as a ladder, stage, or other appropriate device. If a ladder is used, this device shall extend a minimum of three feet below the water surface. Additionally, the means of entering and leaving the water shall be adequate to facilitate rescue of personnel. In any instance where the air gap from the location of the dive station and waterline is greater than 10 ft (3 meters) it is highly recommended that a stage or other appropriate device be the preferred means of entering or exiting the water.

In the case of ROV or other underwater operations other than diving, a safe means of placing into and retrieving equipment from the water shall be employed. Care must be taken to ensure that powered systems cannot create a personnel hazard during these phases of the operation. In any instance where air gap from the location of the dive station and waterline is greater than 10 feet (2 meters) it is highly recommended that a stage or other appropriate device be the preferred means of entering the water.

## 4.13 DECOMPRESSION CHAMBER

1. For any dive in excess of 80 fsw (24.39 m), dives deeper than 60 fsw (18.29 m) when liveboating, or where dives require decompression, a dual-lock decompression chamber having a minimum capability of 6 ATA (equivalent to 165 fsw/50.3 m) shall be available and ready for use at the dive site.
2. Prior to mobilization on jobs not normally requiring a decompression chamber, a Job Safety Analysis shall be performed to determine whether a decompression chamber will be required at the dive location. Those considerations will include but not be limited to:
  - Dive site location with respect to a known and identified location of a decompression chamber that will be available under emergency circumstances.
  - Multi-day and/or repetitive diving operations
  - Potential for diver fouling or entrapment
  - Other potential hazards or factors which may cause the diver to incur decompression obligations
  - Liveboating operations
  - Remote locations

## 4.14 DIVING AT ALTITUDE

For any diving operation conducted at an elevation significantly above sea level, decompression procedures, which take the reduced surface pressure into account, shall be utilized. If in proceeding or departing to the dive location a higher elevation must be transited, that elevation shall be considered to be a factor in the computations.

**WARNING: Diving at altitudes above 10,000 ft (3,050 m) imposes serious stress on the body and is strongly discouraged.**

## 4.15 THERMAL EXPOSURES

Precautions should be taken to protect divers and topside personnel from adverse thermal exposure and maintain proper thermal balance while engaged in operations.

## 4.16 STANDBY DIVER

At least one member of every dive team shall be designated the Standby Diver and should be suitably prepared to enter the water, and when directed by the Diving Supervisor.

Prior to commencement of the operation, the Standby Diver's equipment shall be fully verified as functioning correctly and thereafter maintained in that condition until completion of the dive. Should the Standby Diver be required to enter the water, a surface check shall be completed to ensure proper breathing gas supply, bailout function, and effective communications before the diver leaves the surface.

## 4.17 WARNING DISPLAY

For areas which support marine traffic, an appropriate warning display shall be exhibited near the work site so that it has all-around visibility. This may include but is not limited to shapes, lights, flags, or placards.

## 4.18 RESERVE BREATHING SUPPLY

1. A diver-carried reserve breathing supply must be provided for all diving operations, except where heavy gear (defined as diving equipment of the nature of the U.S. Navy MKV, or equivalent) is involved.
2. A diver-carried reserve breathing gas supply shall provide a physiologically appropriate mixture and capacity for the depths involved.
3. Diver-carried reserve breathing gas supplies must provide a positive indication to the diver that his reserve has been actuated. Such an indication can be the requirement for the diver to open a valve, a visual signal, or other appropriate method.

**Note: Consideration of the reserve breathing gas cylinder duration should be a part of the Job Safety Analysis.**

4. The diver-carried reserve breathing supply shall be of sufficient duration for use until the diver can reach the surface (including any required in-water decompression) from the maximum depth of the dive, another source of breathing media, or be reached by the standby diver equipped with another source of breathing media.
  - The following information is provided to aid in selecting a reserve breathing cylinder size appropriate for the intended dive operation.
  - Consumption can be determined by the following calculation:

$$\text{CONSUMPTION (C)} = \frac{D+33}{33} (\text{RMV})$$

TYPICAL RMV	
0.25 ACFM	Rest
0.70 ACFM	Light Work
1.10 ACFM	Moderate Work
1.50 ACFM	Heavy Work
2.20 ACFM	Severe Work

$$\text{CAPACITY AVAILABLE (VA)} = \frac{VC(N)(PC-PRM)}{PR+14.7}$$

VA = Capacity Available, SCF  
VC = Rated Capacity of Cylinder, SCF  
N = Number of Cylinders



RATED CAPACITY (VC) @ 3000	SERVICE PRESSURE (PC) – Assumed	CAPACITY FT <sup>3</sup> – Assumed
14	2250 (Use Actual)	10.8 (Compute for actual)
30	2250 (Use Actual)	23.2 (Compute for actual)
50	2250 (Use Actual)	38.6 (Compute for actual)
72	2250 (Use Actual)	55.6 (Compute for actual)
80	2250 (Use Actual)	61.8 (Compute for actual)

PC = Measured Cylinder Pressure, PSIG

PRM = Reserve Cylinder Pressure, PSIG

PR = Pressure of Cylinder

#### WATER VOLUME OF TYPICAL RESERVE CYLINDERS

#### EXAMPLE: Planned dive – 220 ft (67 m) with 30 ft<sup>3</sup> reserve cylinder

$$\frac{220 + 33}{33} \text{ (RMV of 1.5)} = \text{Consumption of } 11.5 \text{ ft}^3$$

23.2 ft<sup>3</sup> USABLE GAS

11.5 ft<sup>3</sup> CONSUMPTION = 2.0 MINUTES DURATION

- In all cases the activation of the diver's reserve shall cause the dive to be aborted. The reason for activation of the diver's reserve must be ascertained and corrected prior to continued use of the involved equipment.

## 4.19 COMMUNICATIONS

There shall be a properly functioning two-way audio-communication system between the diver and the normal station of the Diving Supervisor at the dive location except as permitted by **Paragraph 4.28.2 "Scuba,"** in **"Specific Operations Procedures."**

During the conduct of underwater operations other than diving, communications must be established between the Supervisor, Winch Operator, Person in Charge, and other key personnel as determined necessary during the conduct of the Job Safety Analysis.

## 4.20 COMPANY RECORD OF DIVES

Each employer shall establish and maintain a record of each diver's hyperbaric exposure. This record shall contain the following:

- Name and address of the company
- Location, time, and date of diving operations
- Names of the Dive Supervisor, Diver, and Tender/Diver
- Depth of dive
- Bottom time
- Approximate water temperature and thermal protection used
- Environmental conditions (approximate sea state, underwater visibility, and underwater currents)
- Decompression tables and schedule used
- Elapsed time since last pressure exposure if less than 24 hours or repetitive dive designation

- Breathing mixture used and composition
- Type of work performed
- Type of diving equipment worn
- Any unusual conditions
- For each dive for which decompression sickness is suspected or symptoms are evident, the following additional information shall be recorded and maintained:
  - Description of decompression sickness symptoms including depth and time of onset
  - Description and results of treatments

## 4.21 DECOMPRESSION PROCEDURE ASSESSMENT

Each employer shall:

- Investigate and evaluate each incident of decompression sickness based on the recorded information, consideration of the past performance of the decompression table used, and individual susceptibility
- Take appropriate corrective action to reduce the probability of recurrence of decompression sickness
- Prepare a written evaluation of the decompression procedure assessment, including any corrective action taken, within 45 days of the incident of decompression sickness

## 4.22 POSITIONING

Vessels from which diving and other underwater operations are conducted shall afford a safe working platform. Safe operations from dynamically positioned vessels are covered elsewhere in these standards.

## 4.23 PERSONAL PROTECTIVE EQUIPMENT

1. The appropriate ANSI (or standard used within a particular nation) approved personal protective equipment shall be worn when required. These items include but are not limited to:
  - Protective head gear
  - Protective footwear
  - Protective eyewear
  - A personal flotation device to appropriate regulatory standard
  - Hearing protection
  - Safety harness with approved double-locking elastic lanyard
  - Respiratory equipment
2. Appropriate personal protective clothing shall also be worn as necessary to provide protection against hazards encountered in the work environment.

## 4.24 JOB SAFETY ANALYSIS (JSA)

The purpose of the JSA is to provide a written document identifying hazards associated with each step of a job, and to develop solutions that will either reduce, eliminate, or guard against hazards. Keep the sentences short and simple. The ADCI JSA form on the following page can be copied and used as is, or modified to suit individual company needs.

### 1. Sequence of Basic Job Steps

Break the job into observable steps. Try not to be too general or detailed.

- If the job is complex, break it into several tasks: prepare a JSA for each task.



- Begin with an active verb, i.e., disconnect, check, invert, assemble, isolate, start, stop, etc.
- Number each step.

## 2. **Potential Hazards**

Identify possible hazards associated with each step and list that hazard opposite the job step.

- Consider potential accident causes (strain, sprain, slip, fall, cut, crush, etc.).
- Consider environmental and health hazards (vapors, gases, heat, noise, toxicity, etc.).

## 3. **Recommend Safe Procedures and Protection**

Develop solutions for each potential hazard and list the solution opposite the hazard.

- Detail controls, i.e., ventilate, isolate, allow to cool, secure, guard, train, etc.
- List Personal Protective Equipment (PPE) required, i.e., gloves, eye protection, respirators, fall protection, etc.

## 4. **Assign Responsibility**

- Assign a specific person the responsibility of implementing the safety procedures or protection required.

## 5. **Personnel Involved**

- Identify the persons preparing, reviewing, and approving the JSA.
- Distribute the JSA to all personnel involved in the job or task and ensure that each is familiar with the contents of JSA.

## 6. **Revising the JSA**

The JSA should be reviewed and updated whenever new equipment, products, or procedures are introduced into the work site. This is especially true if an accident has occurred on a task upon which a JSA has been performed.



# JOB SAFETY ANALYSIS



Company:		Location:	Date:	Page ____ of ____	New <input type="checkbox"/> Revised <input type="checkbox"/>
<b>Job or Task:</b>					
#	Basic Job Steps	Potential Hazards	Recommended Safe Procedures/Protection	Responsibility	
<b>Prepared By:</b>		<b>Reviewed By:</b>	<b>Approved By:</b>		
<b>Distribution</b>					





## 4.25 ASSIGNMENTS AND RESPONSIBILITIES

Titles, duties, responsibilities, and capabilities of personnel engaged in commercial diving and underwater operations will vary widely. The employer is responsible for assigning personnel to a diving or underwater operation and will ensure all personnel are qualified by training and/or experience to perform the tasks assigned. The following designations indicate the minimum duties and responsibilities of dive team members.

### 4.25.1 Diving Supervisor

A qualified person shall be designated in writing to be in charge of each diving operation. A copy of the written designation must be available for presentation to the designated Person in Charge.

The Diving Supervisor is in charge of the planning and execution of the diving operation, including the responsibility for the safety and health of the dive team. In carrying out these responsibilities, his duties shall include, but not necessarily be limited to, the following:

- Be fully cognizant of all relevant governmental regulatory agency regulations that apply to the diving operation and the diving mode employed, and the employer's basic Safe Practices/Operations Manual. See that all rules and regulations are followed.
- While actually on duty, be in immediate control and available to implement emergency procedures. The Diving Supervisor shall have no other duties than those set forth herein and is not permitted to dive unless another qualified diver is present who has also been appointed and designated to assume responsibility.
- The Diving Supervisor must at all times perform his duties with an ability to manage all aspects of the dive site, to properly direct dive team members in the performance of their duties, and remain ready to respond to emergency conditions. Under emergency circumstances, the Diving Supervisor may enter the water only if it does not interfere with continued assurance that topside supervision will not be lost.
- The Diving Supervisor must also ensure prior to commencing a diving operation, in addition to parties directly involved in the diving operation, that masters of craft, pilots of submersibles, harbor masters, managers of offshore installations, pipelines, civil engineering sites, inland waterways, and all persons responsible for anything that affects the diving operation are advised that diving or underwater operations are to be undertaken. Make available a copy of the Safe Practices/Operations Manual to the Person in Charge of the vessel or facility, with written modifications necessitated by specific operating conditions.
- Ensure diving operations are carried out from a suitable and safe location on the surface.
- Develop or modify and produce pre and post-dive checklists for the operation.
- Develop and implement emergency/contingency procedures.
- Be aware of the procedures to follow to obtain medical support in the event of an accident, either diving or non-diving related. Ensure a two-way communication system is available at the dive location to obtain emergency assistance.
- Perform a Job Safety Analysis for each task undertaken.
- Establish a dive plan ensuring that sufficient breathing mixtures, supplies, and proper equipment are available for safe and timely completion of the job task.
- Assign the duties of all members of the dive team and personally direct them throughout the diving operation.
- Personally verify that all personnel on the dive team are qualified and physically able to perform tasks assigned. He must make an assessment of the physical condition of the divers prior to each dive to determine if any physical impairment is present which would be detrimental to their health and safety in the water or under hyperbaric conditions.



- Ensure that the diving equipment designated for use is:
  - suitable for the planned diving operation
  - sufficient to regulatory requirements for the diving mode used
  - inspected prior to each dive and is in good working order
- Ensure that all relevant operating instructions, manuals, decompression tables, treatment schedules, and regulatory publications are available at the dive location and are maintained to reflect current changes and/or developments
- Ensure the detailed briefing of his diving team and support personnel including:
  - tasks to be undertaken
  - unusual hazards or environmental conditions
- Make modifications to standard procedures or safety procedures necessitated by the specific diving operation
- Maintain a depth, bottom time, and breathing mix profile at the dive location for each diver during the dive
- Ensure that each diver is continuously tended while in the water
- Ensure the dive is terminated when:
  - the diver requests termination
  - the diver fails to respond to communication or communication is lost between the diver and dive team members at the dive location
  - communication is lost between the Person in Charge and the diving supervisor during liveboating operations
  - the diver begins to use his diver-carried reserve breathing gas supply
  - weather or site conditions are degrading to the extent that diver safety may be compromised
- Ensure after every dive:
  - the physical condition and well being of the diver is checked by visual observation and verbal questioning
  - the diver is instructed to report any physical problems or symptoms of decompression sickness or arterial gas embolism
  - the diver is advised of the location of the nearest operating decompression chamber
  - the diver is acquainted with the dangers of flying after diving or traveling to altitudes higher than the dive site
- Ensure after any treatment or dive outside the no-decompression limits:
  - the diver is instructed to remain awake and in the vicinity of a decompression chamber for at least one hour
  - a trained dive team member is available to operate the decompression chamber
- Report all accidents or incidents involving personnel as required by employer rules and relevant governmental regulations
- Maintain and submit reports required by employer and relevant governmental regulations concerning diving operations and equipment maintenance, testing, or repair
- View and ensure accuracy of diver personal log book and affix signature to properly record activities

#### 4.25.2 ROV Supervisor

A qualified ROV Supervisor shall be designated in writing, to be in charge of each ROV operation.

The ROV Supervisor is in charge of the planning and execution of the ROV operation, including the responsibility for the safety and health of the ROV team. In carrying out these responsibilities duties shall include, but not necessarily be limited to:

**ALL DUTIES AND RESPONSIBILITIES OF THE DIVING SUPERVISOR ARE SET FORTH IN PARAGRAPH 4.25.1 ABOVE EXCEPT THE WORDING SHOULD BE IMPLIED TO MEAN ROV OPERATIONS WHERE APPLICABLE.**



**When diving operations are conducted in concert with ROV operations, the Diving Supervisor shall exercise overall control of all underwater operations and shall be the individual empowered to terminate operations to preserve the health and safety of divers in the water.**

#### 4.25.3 Diver

The diver is assigned by the supervisor to perform specific tasks in the water and topside.

A diver shall be at least 18 years old, be medically certified as fit to dive, have completed a formal commercial diving course of instruction, have detailed knowledge of diving theory and practice, a full understanding of the diving equipment in use, and of the tasks assigned. All divers shall be in possession of an up-to-date diver's logbook which can be used to establish levels of experience.

Each diver while carrying out their duties and responsibilities shall:

- Accomplish all tasks assigned by the Diving Supervisor. In the event the diver is assigned a task for which he does not consider himself competent either by training and/or experience, the diver shall immediately inform the Diving Supervisor.
- Read, understand, and comply with all employer's policies and with applicable governmental regulations as they relate to their qualifications or performance while engaging in diving operations.
- Maintain a high level of physical fitness.
- Immediately obey all commands or instructions from the Diving Supervisor to return to the surface, first decompression stop, or bell.
- Ensure that the deepest depth attained during their dive has been established before their ascent.
- Safely transition from the water to the decompression chamber without avoidable delay.
- Act as a Standby Diver when directed to do so. While acting as a Standby Diver, the diver shall:
  - be dressed sufficiently to allow near immediate entry into the water and to stay at depth as long as circumstances require
  - remain at their station throughout the entire dive and in-water decompression
  - monitor the dive radio to constantly remain abreast of events of the dive
- Not be assigned any tasks that might interfere with their duties as a Standby Diver while there is a diver in the water.
- Act as a chamber operator as required by the Diving Supervisor.
- Comply with regulations or instructions concerning the use, maintenance, repair, and testing of all diving equipment provided for the operation.
- Report to the Diving Supervisor any recent medical treatment or illness so that a proper determination can be made concerning their fitness and/or ability to dive.
- Immediately report all symptoms or suspected symptoms of DCS to the Diving Supervisor as early and accurately as possible.
- Report to the Diving Supervisor any defect or malfunction of the diving equipment provided for the diving operation.
- Follow safe diving practices at all times during the diving operation whether on deck or in the water. Bring to the attention of the Diving Supervisor any questionable items. Be alert for the safety of others as well as himself.
- Assist in the training of new personnel or Tender/Divers.
- Remain awake and in the vicinity of the decompression chamber for at least one hour following treatment or a hyperbaric exposure outside the no-decompression limits.
- Know and observe the rules for flying after diving or traveling to altitudes higher than the dive site.

- Ensure that their diving equipment has been correctly maintained, prepared, and tested before each dive. This requirement should never be delegated to others.
- Maintain a diver's logbook which details all dives, medical examinations, courses taken, certification level achieved, and personal equipment maintenance.
- Ensure that medical certificates are up-to-date and recorded in their diver's logbook.
- Present their logbook to the Diving Supervisor on every job for his signature.
- Maintain certification in first aid and CPR.

#### **4.25.4 ROV Senior Pilot/Technician**

- The ROV Senior Pilot/Technician is the individual having completed the prerequisites necessary to begin training as an ROV Supervisor. As such, this individual has progressed through the other categories of ROV personnel (Entry-Level, ROV Pilot/Technician) and consistently improved upon the skills necessary to ensure safety and efficiency of operations.
- The ROV Senior Pilot/Technician shall carry out his normal duties and responsibilities as detailed by management and applicable Safe Practices/Operations Manuals.
- The ROV Senior Pilot/Technician shall, if appointed in writing as an alternate to the ROV Supervisor, be authorized to directly supervise the ROV teams during periods of reduced operations, such as a night shift.
- The ROV Senior Pilot/Technician shall be prepared to manage the ROV team during an emergency.

#### **4.25.5 ROV Pilot/Technician**

- The ROV Pilot/Technician is the individual having completed the prerequisites necessary to advance from the level of Entry-Level ROV Pilot/Technician.
- The ROV Pilot/Technician shall carry out his normal duties and responsibilities as detailed by management and applicable Safe Practices/Operations Manuals.
- The ROV Pilot/Technician shall assist the supervision of launch and recovery operations.
- The ROV Pilot/Technician shall assist the ROV Supervisor to coordinate dive records – video, audio, and written.

#### **4.25.6 Standby Diver**

The Standby Diver is the individual possessing the required training and experience to enter the water at the diving station in order to render assistance to a stricken diver. The Standby Diver in the carrying out of his duties and responsibilities shall:

- Be capable and qualified to carry out all of the duties and responsibilities of the diver as set forth above.
- Have fitted his diving helmet or mask to the Standby Diver's umbilical in a wrench-tight status and then shall check for proper flow of breathing medium and for adequate communications. The diving helmet or mask shall be ready to be donned by the Standby Diver when directed by the Diving Supervisor. He shall remain in the immediate vicinity of the diver water entry location, and be ready to enter the water when directed by the Diving Supervisor.

#### **4.25.7 Entry-Level Tender/Diver**

The Tender/Diver is assigned by the Diving Supervisor to continuously tend a diver. He shall devote his full time and attention to tending the diver he is assigned to from the preparation of the dive until its completion, including any in-water decompression required. He shall not be assigned any other task while the diver is under water. He should further:

- Assist the diver in dressing and undressing.
- Confirm that the diver's equipment is functioning properly and inform the Diving Supervisor that the diver is ready.



- Tend the diver's umbilical (keeping at least one hand on the umbilical at all times) and be aware of the diver's depth and location at all times.
- Set up and operate all equipment as directed by the supervisor or his representative.
- In the event he is assigned a task for which he does not consider himself qualified either by training and/or experience, he shall immediately inform the Diving Supervisor or his representative.
- Perform routine maintenance on diving equipment.
- Repair such equipment as he is qualified to check-out to repair.
- Assist in topside work as required or directed.
- Be alert for and immediately report conditions which may be hazardous or unsafe.
- Maintain certification in first aid and CPR.

As the Entry-Level Tender/Diver gains more experience, his areas of responsibility will expand. His duties and responsibilities may include:

- When qualified, properly operate a decompression chamber as required for decompression or treatment. As a decompression chamber operator, he shall be responsible for:
  - Maintaining the proper depth in the chamber as required by decompression schedule or treatment protocol.
  - Maintaining a proper ventilation schedule so oxygen and carbon dioxide levels remain within safe limits.
  - Decompress or treat the diver in accordance with the schedule as directed by the Diving Supervisor.
  - Maintain communication with the chamber occupants.
  - Properly complete all paperwork as required by employer policy and/or governmental regulations.
  - While operating the chamber, the Tender/Diver shall not be assigned to any other task.
- Before being exposed to hyperbaric conditions, the Tender/Diver must be medically certified as "fit to dive."
- Perform limited tasks as a diver when directed by the supervisor. A Tender/Diver that dives shall be subject to the duties and responsibilities of a diver within the limitations of his assignment.
- When required, ride the chamber with the diver during decompression or treatment. This inside Tender/Diver must be familiar with and alert for the symptoms of oxygen toxicity.

#### **4.25.8 Entry-Level ROV Pilot/Technician**

The Entry-Level ROV Pilot/Technician shall perform such duties as have been directed by the ROV Supervisor consistent with previously received training. Primary responsibilities of this individual are to improve his operational knowledge and to assist other team members as required and directed.

#### **4.25.9 Life Support (Saturation) Technician**

The Life Support (Saturation) Technician is directly responsible to the Diving Supervisor. He must possess the knowledge and ability to perform the duties listed below within the scope of his assignment. This knowledge and skill will have been obtained by a combination of formal training and on-site experience and training. It is recommended that Life Support Technicians maintain a personal logbook which include the details of their work experience and qualifications. The duties and responsibilities of the Life Support Technician will vary depending on the diving mode employed, but at a minimum he shall:

- Conduct such operations as may be required or directed by the Diving Supervisor.

- Perform assigned diving support tasks. Be responsible to ensure that all gasses to be used during the dive have been properly analyzed and have been receipted for and logged in before being placed online.
- Maintain adequate supply of the correct breathing mixture to the diver.
- Maintain correct supply over-pressure for depth and apparatus.
- Have standby banks ready.
- Follow the tables in use correctly and accurately.
- Switch breathing mixtures at the proper time and depth.
- Record gas consumption data as directed.
- Assist in the maintenance of all diving equipment.
- Assist in the training of Tender/Divers and new personnel.
- Report any potentially unsafe situations or conditions to the Diving Supervisor.
- Maintain certification in first aid and CPR, and have a thorough working knowledge of emergency procedures and the diagnosis and treatment of decompression sickness.

In the saturation diving mode the Life Support Technician (Saturation Technician) is employed primarily to control and constantly monitor the hyperbaric environment and system in which divers live while saturation diving. His duties in this diving mode include, but are not limited to:

- Maintain proper atmosphere (i.e., correct levels of oxygen, carbon dioxide, and other gases) and pressure in the saturation complex according to employer's policy and as directed by the Diving Supervisor.
- Maintain proper environment (i.e., temperature and humidity) at levels suitable for current depth as the diver's comfort dictates.
- Decompress divers according to established schedules as directed by the Diving Supervisor.
- Maintain communication with divers.
- Calibration at regular intervals of all monitoring instruments which require, by their design, periodic calibration or at any time the accuracy of the instrument is suspect.
- Maintain an accurate record of events, in the form of a saturation log, pertaining to the diving system. All readings taken and actions during the shift must be entered in the log. They should include:
  - oxygen and carbon dioxide readings
  - depth changes, temperature and humidity readings
  - gas changes, and BIBS usage details
  - carbon dioxide scrubber changes
  - medical lock runs, with record of items locked in or out
  - individual diver's sleep cycles
  - showers, flushes, and drains
  - calibration of instruments
  - bell on and off system and crew TUP's
  - changes to settings on the environmental control system, record of equipment status
  - chamber hygiene and disinfection, diver's ear prophylaxis
  - any event outside normal chamber routines
- Require that diver's requirements within the diving complex together with matters that concern diver's safety and well being are promptly carried out. These include such items as food, drinks, entertainment, personal hygiene and laundry, sanitary matters, etc.
- Be aware at all times of all items being sent in or out of the system, and supervise all such operations. Prevent prohibited items from entering the system.
- Advise the Diving Supervisor of diver's status at regular intervals or as conditions dictate.
- Be alert for emergencies.
- Keep traffic in the control van to a minimum.



- Be aware at all times of the actions carried out by personnel temporarily under his supervision. He must be informed beforehand of any activity to be carried out on the diving complex, its support equipment, or in the near vicinity by other personnel.

## **4.26 SAFETY PROCEDURES CHECKLIST**

The following are minimum guidelines that may require modification for each diving or underwater operations mode to meet individual company needs.

### **4.26.1 Safe Practices/Operations Manual**

- Safety procedure checklist
- Team member assignments and responsibilities
- Equipment procedures and checklist
- Emergency procedures for fire, equipment failure, adverse environmental conditions, medical illness/injury
- Specific individual procedures for tools, equipment, and associated systems
- Available at the dive site to all team members
- Copy to the Person in Charge of the vessel or facility

### **4.26.2 Emergency Aid**

- Decompression chamber (off-site)
- Nearest hospital/medical treatment facility
- Air or ground emergency transportation
- On-call physician
- U.S. Coast Guard, other National Rescue Coordination Centers, or other responding authority
- Emergency rescue source other than U.S. Coast Guard
- Two-way communications available on site and where practical, tested to emergency response link

### **4.26.3 First Aid**

- First aid kit
- First aid manual
- Bag-type manual resuscitator

### **4.26.4 Planning and Assessment**

- Job Safety Analysis
- Site Assessment
- Evaluate environmental pollution containment and response readiness where applicable
- Diving model/equipment system(s)
- Means of water entry and exit
- Breathing gas supplies including reserves (set up and tested)
- Thermal protection (all dive team members)
- Dive team assignments/briefing and fitness to dive
- ROV team assignments/briefing and readiness to conduct operations
- Inert gas status of dive team members (repet dive designations)
- Decompression and/or treatment procedures (including altitude)
- Communications procedures and methods for all personnel involved in the operation
- Emergency procedures
- Dive station setup
- Any necessary modifications to the Safe Practices/Operations Manual



- Written designation of the Diving or ROV Supervisor given to the Person in Charge of the vessel or facility
- Report on the nature and planned times of the intended operation, and the involvement of the vessel or facility's equipment and personnel to the Person in Charge

#### **4.26.5 Hazards to Diving Operations**

- Surface vessel, vehicular traffic, or aircraft operations
- Overhead crane/gantry operations
- Pedestrian traffic
- Displayed diver signals
- Vessel and dive equipment weather limitations

#### **4.26.6 Underwater Hazardous Conditions**

- Umbilical fouling and/or entrapment
- Differential pressures
- Lockout/Tagout
- Contaminated or toxic liquid
- Limited access/confined space/penetration
- Use of explosives or seismic activities
- Underwater sonar
- Cathodic protection
- Marine life
- High currents/severe tidal conditions
- Foreign waterborne materials, such as logs, ice floe, etc.

#### **4.26.7 Record Keeping**

- Project description/accomplishment records completion
- Diving and treatment records, accident reports
- Individual dive and ROV logbook entries appropriate to the intended operation

## **4.27 EQUIPMENT PROCEDURES CHECKLIST**

### **COMMERCIAL DIVING OPERATIONS**

The following are minimum guidelines that may require modification for each diving mode to meet individual company needs.

#### **4.27.1 Equipment Preparation**

1. Assemble, lay out, and inspect all diving equipment and spares intended for the job including all accessory equipment and tools.
2. Check all helmets and masks and ensure that they are within certification and properly functioning.

#### **4.27.2 General Equipment**

1. Check that all accessory equipment — tools, lights, special systems, spares, etc. — are on site and in working order.

#### **4.27.3 Preparing the Breathing Gas Supplies**

1. Check that primary and suitable back-up breathing gas supplies are available, that breathing gases comply with regulations for purity, are available in sufficient volumes, are properly mixed to accommodate the diving mode and profile, and that supply pressures are adequate for the intended operations and helmets/masks to be utilized.



- a. Ensure that the available breathing gas supply pressure is adequate for the intended depth and duration of the dive and that the supply pressure will accommodate the over bottom pressure requirements for the helmet or dive mask to be utilized as established by the manufacturers' instructions.
- b. The over bottom supply pressure requirement for the intended helmet or mask to be utilized on the dive can be determined by reference to the manufacturer's specifications.
- c. Minimum flow requirements for helmets/masks are normally considered to be 4.5 actual cubic feet per minute, however, many manufacturers require a higher or lower flow to ensure adequate ventilation.

Example: Air flow requirements can be calculated by:

$$\text{FLOW} = \frac{D + 33}{33} (4.5 \text{ ACFM})(n)$$

- Standby Diver must be included in the equation. Thus, if the dive will be performed by one individual, (n) will be 2.
- D equals the depth of the intended dive.
- 4.5 ACFM equals the minimum air flow requirement, however, may be higher as determined by the manufacturer's specifications for the intended helmet/mask.

For an intended 220-ft (67-m) dive:  $\text{FLOW} = \frac{220 + 33}{33} (4.5)(2)$  F=69 SCFM

Air pressure can be calculated by:  $P = .445 (D) + 100$  (or, as recommended by manufacturer).

For a 220-ft (67-m) dive, P=197 psig. Therefore a planned 220-ft (67-m) dive with a Standby Diver would require an air supply capable of providing 69 SCFM at a supply pressure of 197 psig.

2. Ensure that the breathing gas supplies are adequate to include decompression, recompression, and accessory equipment throughout all phases of the planned operation.
3. Verify that all breathing gas supply systems have a suitable volume tank and filtration system installed in the air supply line between the supply source and diver's hose connection. A filtration system must be installed between the volume tank and any air source.
4. Verify that all supply hoses running to and from the compressor have proper leads, do not pass near high-heat areas such as steam lines, are free of kinks and bends, and are not exposed on deck in such a way that they could be rolled over, damaged, or severed by machinery or other means.
5. Verify that all high pressure supply and interface hoses have safety lines and strain relief properly attached.
6. Compressors
  - Determine that sufficient fuel, coolant, lubricants, and anti-freeze are available to service all components throughout the operation. All compressors should be fully fueled, lubricated, and serviced.
  - Verify that oil in the compressor is an approved type. Ensure that compressor oil does not overflow the fill mark during servicing as this is a source of potential contamination of the supply. Any oil spillage must be cleaned up immediately.
  - Check that the compressor exhaust is vented away from the work area, specifically that the air compressor intake is not in the path of exhaust gases. Check that the compressor inlet is located in an area free of potential contamination.



- Check that compressors are not covered during operation.
- Check all filters, cleaners, and oil separators for cleanliness.
- Bleed off all condensed moisture from filters and from the bottom of volume tanks.
- Check all manifold drain plugs.
- Check that all valves are properly aligned.
- Check that all belt-guards are properly in place on drive units.
- Check all pressure-release valves, check valves, and automatic unloaders.

#### **4.27.4 Activate the Breathing Gas Supplies**

1. Compressors
  - Ensure that all warm-up procedures are followed correctly.
  - Check all petcocks, filler valves, filler caps, overflow points, bleed valves, and drain plugs for leakage or malfunction of any kind.
  - Leak check all valves and connections.
  - Verify that there is a properly functioning pressure gauge on the air receiver and the compressor is meeting its delivery requirements.
2. Cylinders
  - Check all cylinders for proper pressure.
  - Verify availability and suitability of reserve cylinders.
  - Check all manifolding and valving for operation.
  - Activate and check delivery.

#### **4.27.5 Breathing Gas Hoses**

1. Ensure all hoses have a clear lead and are protected from excessive heating or physical damage.
2. Briefly blow through hoses prior to connection.
3. Check breathing gas hoses and fittings for leaks and flow.
4. Ensure that breathing gas hoses (umbilicals) are properly marked to determine the distance the umbilical is paid out from dive control station.
5. Ensure that breathing gas hoses (umbilicals) are suitable for the gasses to be used and have been maintained in proper conditions of cleanliness.

#### **4.27.6 Test of Equipment with Activated Breathing Gas Supply**

1. Check all exhaust and non-return valves.
2. Hook up all breathing gas hoses to helmets, masks, and chamber; make connection between back-up supply and primary supply manifold.
3. Ensure breathing gas mixture is suitable for depth and diving mode used.
4. Verify flow to helmets and masks.
5. Hook up and test all communications.
6. Check breathing gas flow from both primary and back-up supplies to chamber.



#### 4.27.7 Decompression Chamber Checkout (Pre-dive Only)

1. Check that the chamber is completely free and clear of all combustible materials.
2. Check primary and back-up air supply to chamber and all pressure gauges.
3. Check that the chamber is clean and free from contaminants.
4. Check all chamber BIBS supplies. Verify that sufficient appropriate breathing media is available and that overboard dump systems (if fitted) are functional.
5. Verify the medical kit is available and in close proximity to the chamber.
6. Check all doors and seals.
7. Check that chambers meet code requirements with respect to periodic tests required by ASME/PVHO or equivalent.
8. Check that all valves are in the correct position.

#### 4.27.8 Final Preparations

1. Verify that all necessary records, logs, and timesheets are on the diving station.
2. Check that appropriate decompression and treatment tables are readily at hand.

#### 4.27.9 Remote Operated Vehicle Operations

The following are minimal guidelines that may require modification to suit the conditions of the planned operation.

##### Pre- and Post-Dive Checks

- **Vehicle.** A brief visual and hands-on inspection should be conducted to determine potential or existing problems prior to energizing electrical or hydraulic power. The vehicle should be examined for cracks, dents, loose parts, unsecured wiring or hoses, oil spots, discoloration, dirty camera lenses, or obstructions in the thruster motors. If possible, vehicles should be washed with fresh water after a dive.
- **Electronics.** Each electronic function should be briefly operated.
- **Hydraulics.** Vehicle hoses, connections, and fitting should be examined to ensure proper make-up or signs of abrasion or leakage. Fluid levels should be recorded before and after the dive. The hydraulics should be briefly operated (with caution) on deck to check for leaks or air inclusion. Oil filters should be checked for contamination and changed as appropriate. System pressures should be checked and recorded.
- **Mechanical.** Bolts or couplings should be checked for tightness. All mechanical parts should be kept clean and lubricated, and areas of potential corrosion examined. Major mechanical components should be regularly checked for proper function.
- **Navigation.** All navigational aids should be set on appropriate frequencies and checked for correct operation.
- **Controls.** All control systems should be checked either prior to or as early during the dive as possible. Satisfactory vehicle response should be verified.
- **Work package.** The work package or manipulator systems should be visually checked for condition.
- **Handling system.** The handling system should be examined for damage, for proper operation, and for an absence of leakage.
- **Environmental.** Care should be given to ensure that vehicles are not placed into environmental conditions that may cause damage or malfunction.

## 4.28 SPECIFIC OPERATIONS PROCEDURES

### 4.28.1 Introduction

The specific operations procedures vary with the type of diving mode employed. Prior to mobilization, a Job Safety Analysis shall be performed to determine the type of diving mode to be employed, equipment needed, and job manning requirements.

Prior to the commencement of any diving operation, a Job Safety Analysis shall be completed and all members of the dive team together with other involved personnel shall be present at a pre-dive safety meeting.

### 4.28.2 Self-Contained Diving (Scuba)

Scuba procedures should not be used for the conduct of commercial diving operations except where it can be shown to be more safe and efficient than the alternative modes of diving. The following are minimum requirements for self-contained diving operations:

1. Audio communications are not required for a diver who is accompanied by another diver (buddy) or who can communicate with the tender/diver on the surface through a safety line using pull signals.
2. The planned time of a scuba diving operation shall not exceed either the no-decompression limits or the air supply duration of the cylinders exclusive of the reserve supply. The cylinder pressure shall be determined immediately before each dive. Dive depths shall not exceed 130 fsw (39.63 m).
3. Each diver shall be equipped with a knife, diving wristwatch, and depth gage.
4. A weight belt with a quick release that is appropriate for the suit and depth of the dive shall be worn.
5. A cylinder harness with a quick release shall be worn to secure the breathing mixture cylinders to the diver.
6. The weight belt and cylinder harness shall be independently attached to permit release of either one without interference by the other.
7. A personal flotation device shall be worn at all times.
8. Compressed breathing gas cylinders shall be:
  - a. Annually inspected internally and externally for corrosion and pitting.
  - b. Hydrostatically tested every fifth (5th) year.
9. Scuba dives shall not be conducted against currents exceeding one (1) knot.
10. Scuba dives shall not be conducted in enclosed or physically-confined spaces.
11. During all scuba dives, a Standby Diver shall be available while a diver is in the water.
12. Scuba divers shall be line-tended from the surface, or accompanied by another diver in the water in continuous visual contact during the diving operations.
13. Scuba divers shall be equipped with a diver-carried reserve breathing gas supply.
14. The valve of the reserve breathing gas supply shall be in the closed position prior to the dive.



### 4.28.3 Surface-Supplied Diving

The following are minimum requirements for surface-supplied diving operations:

1. The approximate depth of each dive shall be determined prior to the start of operations.
2. A weight belt appropriate for the diving dress and depth of the dive shall be worn.
3. A separate safety harness with a positive buckling device shall be worn. The harness shall distribute the load on the diver's body, and shall prevent any strain from being placed on the diver's mask or helmet when the umbilical attached to the lift ring on the harness is pulled. Except for heavy gear diving, harnesses should be worn under all other types of equipment.

**At no time shall any member of the dive team be asked to perform an activity that prevents that person from the immediate and continuous performance of assigned duties and responsibilities.**

4. Air dives shall not exceed 190 fsw (58 m) except that dives with bottom times of 30 minutes or less; they may be conducted to depths of 220 fsw (67 m).
5. The breathing mixture supplied to the diver must be composed of a mixture of gases that is appropriate for the depth of the dive. When using mixed gas, all gasses must be analyzed for O<sub>2</sub> content and for proper mixture necessary to support the maximum depth of the planned dive.

**To properly plan for the intended operation, the conduct of a Job Hazard (Job Safety) Analysis is a critical ingredient to assuring that all factors necessary to support the highest levels of safety have been considered.**

**At least one Tender/Diver assigned to each dive crew must be fully competent and designated to perform the duties of a Standby Diver in order to render emergency assistance to a regularly assigned diver.**

**Physically Confining Space:**

**Any space which would restrict the diver's ability to rotate himself head to toe, 180° degrees in any plane and/or when the diver has no direct access to the surface or bell for recovery of the diver from the water.**

6. Mixed gas shall be used as the breathing mixture for dives deeper than 220 fsw (67 m).
7. A decompression chamber shall be ready for use at the dive location as and when required by these Standards.
8. Each diver shall be continuously tended while in the water by a separate dive team member.
9. A diver shall be stationed at the underwater point of entry when diving is conducted in an enclosed or physically-confining space.
10. Each diving operation shall have a primary breathing gas supply sufficient to support all divers for the duration of the planned dive including decompression.
11. Except when heavy gear is worn or where physical space does not permit, a diver-carried reserve breathing gas supply (bailout) shall be utilized.

#### 4.28.4 Air Diving

The following are minimum requirements for surface-supplied air diving operations:

1. Minimum Personnel

The minimum number of personnel comprising a dive team is never less than three (3); however, planning must take into consideration not only the direct requirements of the work to be performed, but also additional factors either known or suspected that may lead to complications during the conduct of the intended operation. Merely because a dive team comprised of three persons may be adequate during one operation does not mean the same number of persons will be sufficient to accommodate the requirements of another.

**Under the conditions cited above, individuals other than a member of the dive team may be used to physically tend cables and/or lines entering the water. These individuals must at all times be immediately responsive to direction from the Diving Supervisor or designated Person in Charge.**

a. Surface-Supplied Air Diving 0 - 80 fsw (0-24.39 m), with no decompression:

- 1 Diving Supervisor
- 1 Diver
- 1 Tender/Diver who shall be properly equipped and capable of performing the duties of a Standby Diver

**In any of the above cases the designated Standby Diver shall be immediately available to enter the water to provide assistance to the diver when directed by the Diving Supervisor.**

**If diving operations are conducted in a physically confining space a diver shall be stationed at the underwater point of diver ingress and immediately available to come to the assistance of the diver. In these conditions the dive team must include an additional Tender/Diver.**

**The Operations Manager and Diving Supervisor must carefully consider manning levels of the dive team. Although regulations may permit diving with a minimum crew of three (3) persons, that level of manning is strictly under optimal conditions. At any time commercial diving operations are intended to take place in a remote location, or from a vessel, or where an air gap from the diving station to the water exceeds 15 feet (4.6 m), at least a fourth (4th) member of the dive team should be scheduled.**

**Note: These are minimum requirements.**

- i. An additional dive crew member is normally required when any diving operation is conducted that has an increased likelihood of diver entrapment or potential for rendering the diver unconscious or incapacitated from chemical, physical, electrical, or topside hazards, such as but not limited to the following when present or planned:
  - During the conduct of the Job Hazard (Job Safety) Analysis, the Diving Supervisor must consider whether the use of any surface-tended equipment by the diver will require an additional individual to tend associated cables or hoses. This includes hand jetting, water blasting, cutting and welding, the use of any pneumatic or hydraulically operated tool, or the use of underwater video or sonar equipment requiring a power or data cable not affixed to the diver's umbilical.
  - Diving in remote locations where assistance from non-diving crew personnel is not immediately available within communication range of the Diving Supervisor may require additional members to be added to the dive team.



**Physically Confining Space:**

**Any space which would restrict the ability of a diver to rotate himself head to toe, 180° in any plane and/or when the diver has no direct access to the surface or bell for recovery of the diver from the water.**

**In the event that diving operations are conducted in a physically confining space a diver shall be stationed at the underwater point of diver ingress and immediately available to come to the assistance of the diver, in these conditions the dive team must include an additional Tender/Diver.**

- Diving under conditions where direct access to the surface for recovery of the diver out of the water is not possible and will normally require an additional dive team member.
  - Any crane or tugger operation associated with the diving operation where the lift wire(s) or sling(s) might possibly interfere with the conduct of intended underwater diving operations.
  - Diving from any mobile offshore drilling unit (MODU), vessel, platform, or other structure where an air gap to the water requires the use of a stage or personnel basket for entry and/or exit.
- b. Surface-Supplied Air Diving 80 - 130 fsw (24.39 - 39.63 m), or less than 80 fsw (24.39 m) when decompression is required:
- 1 Diving Supervisor
  - 1 Diver
  - 1 Standby Diver
  - 1 Tender/Diver
- c. Surface-Supplied Air Diving 130 - 220 fsw (39.63 - 67.07 m):
- 1 Non-Diving Supervisor
  - 1 Diver
  - 1 Standby Diver
  - 2 Tender/Divers
- d. Shallow Operations with Large Crews
- When a diving operation takes place in less than 130 fsw (39.63 m) and the on-shift crew size is 8 or more, then a non-diving supervisor must be part of the crew. For example:
- When two eight-man diving crews are working on different shifts on a single vessel or facility, a non-diving supervisor is required on each shift.
  - When two four-man diving crews are working on the same shift at different locations on a single vessel or facility, a non-diving supervisor is required.
  - When two four-man diving crews are working on different shifts on a single vessel or facility a non-diving supervisor is not required, as there are only four people on deck at any time.
2. Minimum Qualifications of Personnel
- a. Supervisor
- Must have training and/or experience in the following areas:
- Air diving procedures and techniques
  - Emergency procedures
  - Physiology as related to diving
  - Accident treatment procedures
  - Proper operation and use of all equipment related to air diving including decompression chambers

- b. Non-Diving Supervisor
    - A Non-Diving Supervisor is defined as an experienced commercial Diving Supervisor who is not in the diving rotation
  - c. Diver
    - Must have training and/or experience in the following areas:
      - Air diving procedures and techniques
      - Emergency procedures
      - Diving accident treatment procedures
      - Proper operation and use of all equipment related to air diving including decompression chambers
      - Have experience in the use of air diving equipment
      - Familiarity with the type of work engaged in
  - d. Tender/Diver
    - Must have the same qualifications as an Air Diver, with a lower level of experience required.
3. Minimum Equipment
- a. Shallow Air (0 to 80 fsw, 60 fsw when liveboating). All dives outside of the no-decompression limits.
    - Adequate air source and volume tank to support two (2) divers
    - Dive location emergency air source
    - 2 Diving hose groups, each consisting of:
      - Air hose
      - Strength member
      - Communications cable
      - Pneumofathometer hose
    - 1 Set air decompression and treatment tables
    - 1 Safe Practices/Operations Manual
    - 1 Control station consisting of:
      - Communications system
      - Depth gauges
    - Diving ladder or other safe means of getting a diver out of the water
    - 1 Basic first aid kit
    - 2 Sets of diver's personal diving equipment consisting of:
      - Helmet or mask
      - Weight belt if appropriate
      - Protective clothing
      - Tools as required
      - Safety harness
      - Diver-carried reserve breathing gas supply (bailout)
      - Knife
    - 2 time-keeping devices
    - Logbooks and dive sheets. Written JSA applicable to job to be conducted.
  - b. Deep Air (in excess of 80 fsw [24.39 m], 60 fsw [18.29 m]) when liveboating. All dives outside the no-decompression limits.
    - 2 Adequate air sources
    - 2 Volume tanks unless a separate high pressure air tank(s) is being used as a secondary source
    - 1 Double-lock decompression chamber





- 1 Set air decompression and treatment tables
- 1 Diving stage (for all dives deeper than 100 fsw [30.49 m], outside the no-decompression limits, or with heavy gear)
- 2 Hose groups consisting of:
  - Air hose
  - Strength member/strain relief
  - Communications cable
  - Pneumofathometer cable
- 1 Control station consisting of:
  - Communications system
  - Depth gauges
- 2 Time-keeping devices
- 1 Basic first aid kit
- 2 Sets of divers personal diving equipment consisting of:
  - Helmet or mask
  - Weight belt if needed
  - Protective clothing
  - Tools as required
  - Safety harness
  - Knife
- Adequate supply of oxygen
- Spare parts as required
- Logbooks and dive sheets. Written JSA applicable to job conducted.

#### **4.28.5 Surface-Supplied Mixed-Gas Diving (HeO<sub>2</sub>)**

The following are minimum requirements for surface-supplied mixed-gas (HeO<sub>2</sub>) diving operations.

##### **1. Minimum Personnel**

- 1 Non-Diving Supervisor
- 2 Divers
- 2 Tender/Divers
- 1 Life Support Technician

##### **2. Minimum Qualifications of Personnel**

###### **a. Supervisor**

Must have training or experience in the following areas:

- All qualifications required for Air Diving Supervisor
- Mixed-gas diving procedures and techniques
- Proper gas mix selection for various depths
- Gas console operation
- Mixed-gas analyzing equipment
- Special emergency procedures related to mixed-gas diving

###### **b. Diver**

Must have training or experience in the following areas:

- All qualifications required for an air diver
- Mixed-gas diving procedures and techniques
- Operational procedures for gas diving equipment

###### **c. Tender/Diver**

Must have training or experience in the following areas:

- Same qualifications as Air Diver, with a lower level of experience required
- Familiarity with mixed-gas equipment



d. Life Support Technician

Must have training or experience in the following areas:

- Mixed-gas diving procedures and techniques
- Proper gas mix selection for various depths
- Gas console operations
- Mixed-gas analyzing equipment
- Emergency procedures related to mixed-gas diving
- Basic knowledge of air and mixed gas diving techniques
- Diving accident treatment procedures

3. Minimum Equipment

- 1 Complete set of mixed gas diving equipment
- 1 Gas control console
- 1 Gas analyzing instrument
- 1 Open bottom bell (Class II) with emergency breathing equipment and hose group (220 fsw [67.07 m] or deeper)
- 1 Adequate supply of premixed gas or gas mixing equipment
- 2 Helium unscramblers
- 1 Set mixed gas decompression and treatment tables
- 1 Diving ladder or other safe means of getting divers out of the water.
- Logbooks and/or dive sheets.
- Written JSA applicable to job to be conducted.
- An oxygen analyzer fitted in-line on the downstream gas supply to diver(s).

#### 4.28.6 Bell Diving

The following are minimum requirements for bell diving operations:

1. Open Diving Bells (Class II)

Open diving bells shall be provided and used whenever pressure dives exceed the following depth/time limits:

- 220 fsw (67.07 m) or 2 hours in-water decompression.

2. Closed Diving Bells (Class I)

a. Procedures

- A closed bell will be used below 300 feet (91.46 m).
- A minimum of 2 divers shall be used for dives using a closed dry bell.

b. Minimum personnel

In all cases personnel manning and equipment shall be selected to ensure maximum safety during the operation. On small boats/vessels limited by space it may be permissible for the crew to consist of no fewer than three persons; a Diving Supervisor, a Diver, and a Tender/Diver.

- 1 Non-Diving Supervisor
- 2 Bell Divers
- 1 Surface Diver
- 1 Tender/diver
- 1 Life Support Technician
- Additional personnel as required to conduct safe diving operations

c. Minimum Qualifications of Personnel

**Supervisor**

Must have training and experience in the following areas:



- All qualifications required for air and HeO<sub>2</sub> supervisors
- Bell diving procedures and techniques
- Proper gas mix selection for various depths
- Gas control console operation
- Mixed-gas analyzing equipment
- Special emergency procedures related to bell diving

**Diver(s)**

Must have training and experience in the following areas:

- All qualifications required for air and HeO<sub>2</sub> diver
- Bell diving procedures and techniques
- Proper gas mix selection for various depths
- Operational procedures for bell diving equipment

**Tender/Diver**

Must have training or experience in the following areas:

- Same qualifications as Air Diver, with a lower level of experience required
- Familiarity with mixed gas and bell equipment

**Life Support Technician**

Must have training or experience in the following areas:

- Life support system operation and maintenance
- Bell diving procedures and techniques
- Proper mix selection for various depths
- Gas console operations
- Mixed-gas analyzing equipment
- Emergency procedures related to bell diving
- Basic knowledge of air and HeO<sub>2</sub> diving techniques
- Diving accident treatment procedures

d. Minimum Equipment

- All equipment required for mixed-gas diving
- Necessary equipment for bell operations (depending on type)

**4.28.7 Liveboating**

The following are minimum requirements for liveboating operations:

1. Depth/Time Limits

The maximum depth/time limits for liveboating operations is 220 fsw (67.07 m) or 2 hours in-water decompression.

2. Minimum Personnel

In all cases personnel manning equipment shall be selected to ensure maximum safety during operation. On small boats/vessels limited by space it may be permissible for the crew to consist of no fewer than three persons; Diving Supervisor, a Diver, and a Tender/Diver.

a. Air Diving (0 - 60 fsw [18.29 m])

- 1 Diving Supervisor
- 2 Divers
- 2 Tender/Divers

In all cases personnel manning equipment shall be selected to ensure maximum safety during the operation. On small boats/vessels limited by space it may be permissible for the crew to consist of no fewer than three persons; a Diving Supervisor, a diver, and a tender/diver. When crew size is eight persons or more, at least one member of the crew will be a Non-Diving Supervisor.

- b. Air Diving (60 - 220 fsw [18.29 - 67.06 m])
  - 1 Non-Diving Supervisor
  - 3 Divers
  - 2 Tender/Divers
- c. Mixed-Gas Diving (any depth)
  - 1 Non-Diving Supervisor
  - 3 Divers
  - 2 Tender/Divers
  - 1 Life Support Technician

### 3. Minimum Qualifications of Personnel

#### **Supervisor**

- Must be experienced in liveboating and knowledgeable in all facets of the time and depth for the job at hand or dive being conducted.

#### **Tender/Diver**

- Shall be familiar with liveboating operations.

#### **Diver**

- Shall be experienced in liveboating operations.

#### **Vessel Captain**

- Should be experienced in liveboating operations to the satisfaction of the supervisor.

### 4. Vessel

- a. The vessel shall be acceptable to the diving company and the Diving Supervisor.
- b. A “kill switch” shall be in the immediate vicinity of the operator of the boat for instantaneous shutdown of the engines.
- c. For operations on dynamically positioned vessels see **Section 7, Dynamic Positioned Vessel Diving Systems and Operations.**

### 5. Minimum Equipment

(Additional to standard equipment required for the desired diving mode/depth)

- a. On all liveboating operations, a third (3rd) diving hose connected to the manifold shall be available for emergency use except in the case of small boats or vessels where sufficient space for a third diving hose and associated equipment may not be available.
- b. On all liveboating jobs, a bailout bottle shall be worn by the diver.
- c. A free-floating decompression buoy or equivalent is to be used in liveboating operations whenever in-water decompression may become necessary.
- d. A means will be used to prevent the diver's hose from becoming entangled in the propellers of the vessel.
- e. A secondary breathing gas supply to the manifold for surface supplied diving must be sufficient to support the following:
  - The diver while returning to the surface
  - The diver during decompression
  - The Standby Diver and main diver at the same time



6. Procedures
  - a. Continuous and easily understandable communications will be maintained between the dive station and wheelhouse at all times.
  - b. The boat will be maneuvered in such a manner so as to permit the Tender/Diver or Diving Supervisor to continuously monitor the direction of the divers' umbilical with respect to the diving control station.
  - c. The propellers of the vessel are to be stopped before the diver enters or exits the water.
  - d. Liveboating shall not be done:
    - In seas that impede the station keeping ability of the vessel
    - In other than daylight hours
    - During periods of restricted visibility
    - Any time existing conditions make liveboating unsafe in the opinion of the boat captain and/or supervisor
  - e. A Standby Diver will be continuously prepared to enter the water when directed by the Diving Supervisor.
  - f. All liveboating operations shall be tended from the bow and the boat shall be operated from the wheelhouse or flying bridge.

#### 4.28.8 Saturation

The following are minimum requirements for saturation diving operations.

1. Minimum Personnel

Saturation diving minimum personnel requirements shall be the same as for bell diving, with the additional personnel needed to operate the system safely on a 24-hour basis.
2. Minimum Qualifications of Personnel
  - a. Supervisor

Must have training and/or experience in the following areas:

    - All qualifications required for air, HeO<sub>2</sub>, and bell supervisor
    - Saturation diving procedures and techniques
    - Gas mixing and proper mix selections for various depths
    - Gas control console operation
    - Mixed-gas analyzing equipment
    - Special emergency procedures related to saturation diving. System life support equipment.
  - b. Diver

Must have training or experience in the following areas:

    - All qualifications required for air, HeO<sub>2</sub>, and bell diver
    - Saturation diving procedures and techniques
    - Operational procedures for saturation equipment
  - c. Tender/Diver

Must have training or experience in the following areas:

    - Same qualifications as Air Diver, with a lower level of experience required
    - Familiarity with mixed-gas and bell equipment
  - d. Life Support Technician

Must have training or experience in the following areas:

    - Saturation diving procedures and techniques. System life support equipment.
    - Gas mixing procedures
    - Proper gas mix selection for various depths
    - Gas console operations
    - Mixed-gas analyzing equipment

- Emergency procedures related to saturation diving
  - Basic knowledge of air, HeO<sub>2</sub>, and bell diving techniques
  - Diving accident treatment procedures
3. Minimum Equipment
    - All equipment required for mixed-gas diving excluding a Class II bell
    - Necessary equipment for bell and saturation diving (will vary depending on type of system)
  4. Maximum Allowable Oxygen and Nitrogen Limits
    - a. Long Duration Oxygen Limits
 

The maximum continuous oxygen level in a saturation habitat shall be consistent with minimizing the effects of pulmonary oxygen toxicity.
    - b. Partial Pressure of Nitrogen
 

The partial pressure of nitrogen in the breathing mixture to divers working underwater shall not exceed recommendations of competent medical authority.

**WARNINGS**

- **Incomplete or inadequate decontamination of divers may contaminate recompression chamber and present a fire hazard.**
- **Respiratory hazards in hyperbaric environments may cause more severe health effects than experienced at normobaric pressures.**

#### 4.28.9 Contaminated Water Diving Operations (See Section 12, Commercial Diving in Potable Water Facilities)

When evaluating the wisdom of conducting commercial diving operations where contaminated conditions are suspected, or known to be present, great care must be given to the planning and assessment phases. Although a decision to proceed with such operations is one of a business nature, safety considerations must be a primary determinant. Conduct of these types of operations with less than properly trained and equipped personnel and with an absence of knowledge of the specific contaminants to which the diver and dive team members may be exposed can create a significant hazard.

An important ingredient of contaminated water diving operations is to minimize the length of time during which members of the dive team are exposed to contaminants. Dives should be scheduled to require no in-water decompression so as to limit the diver's exposure to waterborne hazards.

The information presented in this section has been generated as guidance material that must be considered when planning the conduct of contaminated water diving operations.

1. Training
  - a. Personnel who are likely to participate in contaminated water diving operations should receive training the equivalent of that outlined in 29 CFR 1910.120 (U.S. OSHA) – Hazardous Waste Operations and Emergency Response (HAZWOPPER).
  - b. Additional training of all personnel who will participate in the diving operation must recognize that topside personnel will likewise be exposed to contaminants. As such, these personnel must be properly protected from the effects of the contaminants, be treated as having been exposed, and will require decontamination.
  - c. Specific training must be furnished in:
    - i. Drysuits
    - ii. Personal protective clothing



- iii. Decontamination procedures including preparation of the disinfectant or other solution intended for use
  - iv. Decontamination of equipment used during operations
2. Site Evaluation
- a. When operations will take place where the water is suspected or known to be contaminated, a site assessment must be conducted. This assessment should include:
    - i. Wind: In situations where there may be toxic fumes, the dive station, compressor, and topside personnel must be situated up-wind from any source of contamination to the air.
    - ii. Current: Both on the surface and underwater, the diver should approach any known point-source of contaminant from the up-current side whenever possible. This will allow the current to carry contaminants away from the diver.
    - iii. Perimeter: Whenever possible, a perimeter should be established around the dive station and dive site to keep unprotected persons away from any possible contamination.
    - iv. Established zones: Zone management should be employed to keep unprotected personnel and equipment outside of the hot zone.
    - v. Testing of the dive environment: It is not always possible to tell whether an environment is contaminated either by sight or by smell. Any diving environment should be approached with caution and when contamination is suspected, the water tested prior to commencement of operations.

### Protective Equipment for Topside Personnel

Level A (Most Protective)	Level B	Level C	Level D (Least Protective)
Exposure to vapor gases that can affect respiratory system or skin. Possibility of splash, immersion, or exposure to harmful substances. Working in confined/poorly ventilated areas.	Possible respiratory dangers exist but vapors will not be absorbed through, or affect skin. Splash, immersion, or exposure to skin is expected, but substances harmful to skin or capable of being absorbed through the skin are present. Personnel must work in confined/poorly ventilated areas.	Concentration and type of airborne substance is known and an air purifying respirator provides sufficient protection. Splash, immersion, or exposure to skin will have minor impact due to skin absorption.	Atmosphere contains no known hazards. No risk of any contact or inhalation of hazardous levels of chemicals.
Positive pressure, full-face mask and/or scuba. Inner and outer chemical-resistant gloves. Boots or shoes with chemical resistance. Certified suits.	SCBA, positive pressure. Hooded chemical-resistant clothing; one-or two-piece chemical splash suit. Inner and outer chemical-resistant gloves. Boots or shoes with chemical resistance.	Full-face or half-mask, air purifying respirator. Hooded chemical-resistant clothing – can be two pieces. Outer and inner chemical-resistant gloves. Boots that have chemical resistance.	Coveralls. Boots or shoes with chemical resistance. Safety glasses or chemical splash goggles.

- b. Certain environments may be polluted with chemical or biological contaminants. Examples of environments in which this is true are:
      - i. Harbors and ship channels
      - ii. Sewer outfalls
      - iii. Lakes that received run-off from agriculture
      - iv. Pulp mill outfalls
      - v. Rivers that run through industrial areas
  3. Hazard Evaluation and Identification
    - a. When a threat of chemical hazard is suspected, consider conducting a historical review of the site. Items such as spill history, known chemicals present, volume of chemicals, active discharges, air quality, present and past nature of operations, and presence of extremely hazardous substances should be examined. Facility safety officers, plant supervisors, or technicians may provide useful information.

### DIVER-WORN EQUIPMENT AND ACCESSORIES

Level One (Most Protective)	Level Two	Level Three (Least Protective)
For diving in waters containing biological contamination, petroleum fuel, lubricating oils, and industrial chemicals known to cause long-term health risks or death.	For diving in waters containing biological or chemical contamination that will cause short-term health effects but will not cause lasting injury, disability, or death.	Recommended for diving in waters that are considered to pose a minimal health risk.
<p>Helmeted surface-supplied diver with mating dry suit with attached boots, gloves, and a return line exhaust or double exhaust valve system.</p> <p>Surface-supplied helmeted diver with attached breach ring or breastplate sealed to a dry suit with attached gloves and boots. The helmet gas supply configuration can be a free flow or demand system design.</p>	<p>Scuba or surface-supplied umbilical with dry suit with attached and sealed hood, gloves, and boots.</p> <p>Full-face mask that overlays the hood face seal.</p>	<p>Scuba/surface-supplied umbilical with half-mask or full-mask, chafing overalls, hand and foot protection.</p> <p>Scuba/surface-supplied umbilical with wet suit, gloves, boots, hood, and half-mask or full-face mask.</p>
<p>Note: the use of Level Three protection should take into consideration the chemical compatibility of the equipment being used and the resultant permeation of waterborne contamination into the equipment.</p> <p>Diving in waters containing strong chemicals or nuclear contamination where even minor exposure could cause a serious threat will require special consideration and planning, equipment precautions, and training.</p>		





- b. Check with local, state, or federal water quality agencies for current advisories on biotoxins, waterborne pathogens, microbial contamination, fish or shellfish advisories, beach closures, or storm events, any of which may indicate pollutants to be present.
- c. When hazardous contaminants are suspected consider water or sediment sampling and analysis. If possible, analysis should be conducted at an off-site laboratory to obtain the most sensitive and accurate results. The selected laboratory can provide proper containers and procedures for sample collection, handling, and shipping.
- d. If the pollutants have been identified, rapid on-site test kits for selected chemicals in sediment or water are, in some cases, available.

**If severe contamination is known to be present at the planned site of diving operations, consideration should be given to using an ROV rather than to risk the health and safety of the diver and dive team members.**

- e. Hand-held detectors for monitoring a class of airborne chemicals, such as volatile organics, can be utilized for:
    - i. Initial entry into the staging area during mobilization if the air quality is unknown.
    - ii. Continuous monitoring with alarms during diving operations to rapidly notify the participants if air quality changes.
    - iii. Scanning the diver upon water exit and after decontamination to determine if contaminants are present.
  - f. Lists of very dangerous chemicals that may readily penetrate diving equipment or cause substantial harm after a brief exposure can be obtained. If a diver or topside crew member suspects exposure, blood, urine, or other biological samples may be gathered for medical review.
  - g. Some chemicals may break down or permeate diving equipment. Brief exposure to some can cause injury through inhalation, ingestion, or skin contact, or a combination of the three.
4. Protective Equipment for Topside Personnel
- a. Before any diving operation is conducted in contaminated water a risk assessment is vital. Personal Protective Equipment (PPE) must be selected based on its known ability to protect workers from the specific hazards present or suspected. This applies to the diver and the topside personnel.
  - b. Key variables that must be considered when selecting PPE are:
    - i. Identification of the hazard(s)
    - ii. Route of potential hazard to employees, i.e., inhalation, skin absorption, ingestion, and eye or skin contact
    - iii. The performance of PPE materials, seams, visors, and all other vital components
    - iv. Matching PPE durability of materials such as seam, tear, burst, and abrasion strength to dive site-specific conditions
    - v. Matching site environmental conditions to PPE effect on employees (i.e., heat stress, hypothermia, dehydration, duration of task, etc.)

**Any actual or suspected breach of a Level Three diving system is cause for the immediate termination of diving operations.**

- c. Equipment selection (PPE). Selection of personal protective equipment is a complex task. Site specific variables must be considered and protection geared to the worst case situation if those variables are not positively identified. The more that is known about the site, the easier it will be to customize suitable PPE to ensure protection of the dive team topside members.



- d. There are four different categories of PPE from the least protective — Level D — to total encapsulation – Level A. Requirements for these levels are set forth in the following table:
5. Diver-Worn Equipment and Accessories
- a. Selection of the diver-worn equipment must be based on the level of contamination protection required. The following equipment configurations are only recommendations! Responsibility for selection of equipment and diving technique must be made by the persons engaged in the diving activity as identified in a Job Safety Analysis.
  - b. Equipment that supports the diver must also be compatible with the contaminants that may be encountered. This includes umbilicals, systems and fittings used to assemble umbilicals, bailout systems, weight belts, harnesses, and similar items.
  - c. There are three levels of protection for diver-worn equipment and accessories from the most protective – Level One — to the least protective – Level Three. Requirements for these levels are set forth in the table.
6. Decontamination Procedures
- a. The area surrounding the diving control station should be divided into three (3) zones for proper sequestration of contamination. The zone immediately surrounding the point of water entry/exit is deemed “high contamination.” The zone where divers and gear progress after initial decontamination is termed “low contamination.” The final zone into which the divers progress after they have been decontaminated and all diving gear removed is “clean.”
  - b. An effective color-coding system may be employed to communicate clearly the demarcation point of the decontamination area. One system might be to use red to identify all “high” areas, yellow for “low” areas, and green for “clean” areas. If at all feasible, the “clean” zone should be positioned up-wind of the contaminated zones.
  - c. **Initial Freshwater Rinse:** Spray off bulk of contaminants using high-pressure, clear freshwater rinse. If effluent does not require capture, begin hosing diver as he initially exits water to limit quantity of contaminants transferred to the dive station.
    - i. Take precautions to direct water flow away from potential points of leakage of diver’s rig such as exhaust valves, seal junctions, etc. A high-pressure jet of water directed at such potential breach points may inject contaminants inside of the protective gear and into contact with the diver. Care should be taken to ensure the removal of the bulk of contaminants at this stage in order to afford the greatest efficacy of subsequent decontamination steps.
  - d. **Oversuit:** If a reasonable expectation exists for encountering bulky, adherent contaminants in the course of a dive, the use of a disposable oversuit is strongly encouraged. Disposable hazardous material protective suits can be secured to a diver after he has been outfitted with the entire diving rig.
    - i. No effort to make the oversuit water-tight should be attempted. Such action could complicate the dive by creating air pockets that could affect buoyancy of the diver. As the diver arrives on the dive station the oversuit should be cut away to allow for decontamination of the diver and equipment. At this time removal of dive gear such as harnesses, weight belts, emergency gas supply (bailout) tanks, etc. should be effected with these items themselves properly decontaminated.
  - e. **Scrub Down:** After the diver has been initially rinsed and his equipment removed, the diver should be scrubbed with a stiff-bristle synthetic brush and a cleaning solution. Long-handled brushes may facilitate the cleaning process. Hand-held brushes should be employed for detailed cleaning of the dive helmet and the neck-dam interface.



- i. Once the diver has been thoroughly scrubbed with cleaning solution applied from head to toe, he should be rinsed with fresh water. Care should be taken to ensure the diver has been cleaned of all visible contamination, most notably in the area adjacent to the neck-dam, helmet, and dry suit. Once diver has received a final rinse, he should progress to the clean area.
  - ii. The composition of the cleaning solution should be appropriate for the contaminant to be removed. While a 5% bleach solution may be adequate for biological contaminants it is often not used for industrial chemicals. One method for preparing a 5% bleach solution is to mix three pounds of HTH (high-test hypochlorite, calcium hypochlorite) into 5 gallons of fresh water. A chlorine-based solution should not be used for cleaning if the contaminants contain an appreciable amount of ammonia. A cleaning solution of 1 to 2% tri-sodium phosphate (TSP) should work well for such scenarios.
- f. **Undress Diver:** Once the diver has been adequately decontaminated and moved into the “low contamination” zone, the dive gear should be removed. First, disconnect the locking mechanism from the helmet to dry suit and remove the helmet. Then, remove the dry suit and gloves, and finally, undergarments.
  - i. If there are no indications that the diving rig has been breached during the dive, the diver may proceed to the “clean” zone and take a routine post-dive shower. The shower should include complete washing of the body with soap/shampoo. Additionally, fingernails should be thoroughly scrubbed with soap and a nailbrush and mouthwash used at the discretion of the diver.
  - ii. If there are positive indications of dermal exposure to contaminants, additional decontamination measures may be required.
- g. **Clean Equipment:** Subsequent to removal from the diver during the personnel decontamination procedures, all equipment must undergo secondary decontamination. This entails first rinsing bulk contamination from equipment and then soaking in an appropriate surfactant solution for 30 minutes.
  - i. After soaking, equipment should be rinsed thoroughly until no foaming occurs. Impermeable covers should be applied to ensure cleaning solutions are not introduced into the gas transport orifices of umbilicals or other types of air-handling apparatus.
- h. **Capture Effluent:** In some circumstances it will be necessary that all fluids used to rinse, wash, and re-rinse the diver and equipment must be captured for appropriate hazardous material disposal. If true, the above procedures will need to be altered to ensure that all fluid-related actions take place within a water impermeable capturing area.
  - i. Where effluent capture is necessary, all fluids should be pumped or poured into appropriate storage and transport containers prominently marked “hazardous material.”

## 4.29 DIVING WITH ROV's

Divers and remotely operated vehicles (ROV's) may be working in the water at the same time. The use of an ROV to monitor the diver enhances the safety of manned diving operations. Procedural guidelines must be established before mutual operations begin. The following items should be discussed by the divers, Diving Supervisor, ROV Supervisor, ROV Pilot/Technicians, and Vessel Master before any dual diving/vehicle operations commence:

1. Establish a clear chain of command. All ROV operations must be coordinated through the Diving Supervisor.
2. Set up two-way voice communications between the Diving Supervisor and ROV Pilot (and the Vessel Master, if liveboating or on DP operations). An ROV video monitor should be set up at the diving station. If communications are lost, the ROV must maintain position. Notify the diver immediately.
3. All ROV movements, i.e., launch, recovery, and movement around the work site, must be cleared through the Diving Supervisor if a diver is in the water.
4. The ROV must never approach a diver without warning. Neither should the diver approach, handle, or ride a vehicle without first informing topside and receiving permission.
5. The diver should be aware that some ROV's may pose a serious electrical shock hazard.
6. ROV thrusters should be fitted with guards.
7. Care must be taken to ensure that the diver umbilical and ROV umbilical do not become crossed.
8. If the diver's hose and ROV umbilical become entangled, the ROV must maintain station until the diver can survey the situation.
9. ROV sonar and locating devices may pose a hazard to the diver.
10. A large ROV can injure a diver by collision.
11. The lights of an ROV can temporarily blind a diver. Concurrently, the diver's light can blind the ROV's video system.
12. The diver should not use the ROV's tether as a down line.
13. If the ROV pilot cannot determine the position of the ROV due to poor visibility, high currents, or any technical reason, he must inform the Diving Supervisor immediately. A plan of action for this eventuality should be determined before operations commence. A suggested procedure is to:
  - Secure all power to the thrusters and allow the vehicle to float clear of the job site (lights, video, and sonar still powered up)
  - Inform the diver of the situation
  - Establish position and request diver to confirm status and attitude of the ROV
  - When clear of the diver, maneuver ROV back to the work site or recovery position as appropriate.

## 4.30 HAND-HELD POWER TOOLS

The following are minimum requirements for hand-held power tools. Prior to use of any hand-held power tools a Job Safety Analysis shall be performed.

### 4.30.1 Electrical Hazards

1. All hand-held electrical tools, including hand-held electrical equipment inside bells and habitats, shall be de-energized at the surface before being placed into or retrieved from the water.



2. All underwater electrical equipment powered from topside shall be equipped with a ground fault interrupter (GFI) between the power source and the tool.

#### **4.30.2 Switches and Controls**

1. All hand-held power tools (i.e., hydraulic and pneumatic tools, water blaster guns) shall have a constant pressure switch or control (except for underwater welding and burning equipment).
  - Hand-held power tools shall not be supplied with power from the dive location until requested by the diver.

### **4.31 WELDING AND BURNING**

The following are minimum requirements for welding and burning. Prior to performing welding or burning operations a Job Safety Analysis shall be performed.

#### **4.31.1 Grounding**

Welding machine frames shall be securely grounded.

#### **4.31.2 Insulation & Capacity**

Welding cables, electrode holders, and connections shall be properly insulated and capable of safely carrying the maximum current required by the work.

#### **4.31.3 Disconnect Switch**

Welding electrical circuits shall have a positive disconnect switch located at the dive control station and capable of being immediately operated by the person running the dive. The switch shall remain open except during actual welding or burning.

#### **4.31.4 Protective Apparel**

Insulated gloves shall be worn by the diver while engaged in underwater welding and burning.

#### **4.31.5 Inert Gas Purging**

Closed compartments, structures, or pipelines which are subjected to the heat of welding or burning shall be flooded, vented, or purged with water or an inert gas which will not support combustion prior to welding or burning, except during hot tapping operations.

### **4.32 EXPLOSIVES**

The following are minimum requirements for employing explosives. Prior to the use of explosives a Job Safety Analysis shall be performed.

#### **4.32.1 General**

Employers must transport, store, and use explosives in compliance with 29 CFR 1910.109, 29 CFR 1926.912, and with the requirements of this section. Other state and local regulations may apply.

#### **4.32.2 Transport and Storage**

Single component explosives shall be transported and stored in magazine boxes. Blasting caps will not be stored with explosives.

#### **4.32.3 Circuit Tests**

Electrical continuity of explosive circuits shall not be tested with divers in the water.

#### **4.32.4 Area Clearance**

Divers shall be out of the water before explosives are detonated.

#### **4.32.5 Detonation Devices**

All detonation devices shall be placed and maintained under the custody of the Diving Supervisor when divers are in the water or when personnel on the surface are in the vicinity of explosives.

### **4.33 EMERGENCY PROCEDURES**

The following emergency procedures that may affect the health and safety of personnel are offered as minimum guidelines to assist companies in developing their own specific detailed emergency procedures. The steps that are listed may not be in order of preference. Each emergency will dictate its own priorities. In general, every emergency will cause the dive to be aborted until the cause has been fully remedied.

#### **4.33.1 Loss of Breathing Media**

1. Re-establish breathing media supply by:
  - Activating topside secondary breathing media supply, or
  - Diver goes on bailout bottle, or
  - Put breathing media to diver's pneumo hose and have diver insert pneumo hose into helmet/mask.
2. Alert standby diver.
3. Diver goes to bell/stage.
4. If required, send Standby Diver to diver's assistance.
5. Terminate dive.

#### **4.33.2 Loss of Communications**

1. Attempt to establish line-pull signals.
2. Put air to diver's pneumo.
3. Alert Standby Diver.
4. Diver proceeds to downline/bell stage (if bell, attempt to use bell communications).
5. Bring diver to first stop once line-pull signals are established.
6. If required (unable to establish any form of communications with diver), send Standby Diver to diver's assistance prior to bringing diver to his first stop.
7. Terminate dive.

#### **4.33.3 Fouled or Entrapped Diver**

1. Avoid panic and ensure diver does not ditch equipment.
2. Diver informs topside.



3. Alert Standby Diver.
4. Diver determines extent of entrapment.
5. Diver attempts to free himself.
6. If required, send Standby Diver to diver's assistance.
7. When diver is free, if unable or unwilling to continue the dive, or if Standby Diver was required to go to his assistance, terminate dive.

#### **4.33.4 Injured Diver in Water**

1. Diver informs topside and dive is aborted.
2. Alert Standby Diver.
3. Diver determines nature and extent of injury.
4. If required, send Standby Diver down to assist diver, administer first aid, and evaluate injury. Standby Diver should remain with diver.
5. Standby Diver assists injured diver to surface, following proper decompression procedures, except when severity of injury indicates a greater risk than omitting decompression.
6. Request required medical assistance and emergency evacuation (if required).
7. Monitor breathing. If breathing stops, overpressure diver's regulator, if possible.

#### **4.33.5 Severance of Diver's Umbilical - Gas Hose Only**

1. Put breathing media to diver's pneumo hose.
2. Diver activates bailout bottle.
3. Alert Standby Diver.
4. If required, diver inserts pneumo hose inside helmet/mask.
5. Diver returns to bell/stage.
6. Diver activates and uses emergency breathing media on bell/stage.
7. Terminate dive and follow proper decompression procedure.
8. If required, send Standby Diver down with additional bailout bottle or hose.

#### **4.33.6 Severance of Complete Umbilical**

1. Diver activates bailout bottle.
2. Alert Standby Diver.
3. Diver returns to bell/stage.

4. Diver activates and uses emergency gas on bell/stage.
5. If umbilical severed on deck and the end of the umbilical is still on deck, send Standby Diver down umbilical with new hose/bailout bottle. Otherwise, send Standby Diver down downline or bell stage cable.
6. Terminate dive and follow proper decompression procedure.

#### **4.33.7 Fire in Equipment**

1. Extinguish fire; secure equipment.
2. Determine damage and effect on diver.
3. If required, terminate dive; commence decompression.
4. Each chamber must have a means of extinguishing a fire in the interior.

#### **4.33.8 Equipment Failure - Diver in the Water**

**Dive emergencies such as bailout, bends, omitted decompression, embolism, etc. are addressed in the following section: "Guidelines for Treatment of Decompression Incidents."**

1. Evaluate effect on diver.
2. Inform diver of problem and action planned.
3. Alert Standby Diver.
4. Alert deck crew.
5. Diver informs topside of his readiness.
6. Activate plan, terminate dive.

#### **4.33.9 Oxygen Toxicity in Water**

1. Supervisor notes signs or diver reports symptoms to topside.
2. Reduce oxygen partial pressure (switch to air), or lower PPO<sub>2</sub> of mixed gases.
3. Continue decompression on appropriate table unless a 50/50 nitrox mix is available for in-water decompression use.

#### **4.33.10 Oxygen Toxicity During Treatment**

1. Diver reports to topside.
2. Instruct diver to remove oxygen mask for 15 minutes. After all symptoms disappear, then start oxygen again. Do not count time not on oxygen. Recommence decompression where oxygen stopped.
3. If oxygen toxicity symptoms occur for the second (2nd) time, repeat Step 2.
4. If oxygen toxicity symptoms occur for the third (3rd) time, discontinue oxygen and immediately request medical advice and assistance from designated point of contact.



#### **4.33.11 Emergency Evacuation**

1. Notify diver and all surrounding personnel of emergency and terminate dive.
2. Decompress diver according to proper decompression procedures. If not possible, follow omitted decompression procedures.
3. Evacuate all unnecessary personnel to safe platform.
4. Contact management and inform them of conditions as soon as possible.  
Additional emergency procedures should be developed as needed, possibly including but not limited to:
  - Loss of power supplies
  - Loss of SDC (bell)
  - Loss of ROV
  - Adverse environmental conditions, including but not limited to:
    - Weather
    - Sea stat



## SECTION 5.0

# EQUIPMENT AND SYSTEMS





## 5.0 EQUIPMENT AND SYSTEMS

### 5.1 SCOPE

The equipment described in this section of the *ADCI Consensus Standards for Commercial Diving and Underwater Operations* must meet requirements contained in 29 CFR 1910 Subpart T —Commercial Diving Operations (OSHA), and/or (as appropriate), 46 CFR Ch. 1, SUBCHAPTER V, Part 197, Subpart B —Commercial Diving Operations (USCG).

Where these standards are intended for use in areas outside U.S. jurisdiction, the national laws of the nation in which the operations are to be conducted shall be adhered to.

The documents referenced above set forth the minimum requirements for equipment and operations.

Equipment must also meet minimum requirements as described in this chapter.

The dive control station shall be located to be as close to the dive site as possible and shall be laid out to furnish the Diving Supervisor easy access to all relevant areas of control. The dive control station shall feature good visibility of all gauges and displays and must be adequately illuminated for operations during reduced visibility or darkness. Suitable fire fighting arrangements and devices must be furnished to combat the fire and respond to such an incident.

#### 5.1.1 General

A wide range and variety of equipment may be required to support commercial diving and underwater operations. Equipment utilized shall be that necessary to assure the safe conduct of operations under the conditions under which it shall be employed.

Equipment such as helmets, masks, bailout systems, regulators, etc. which provide direct life support shall be of a type familiar to the diver and subject to a planned maintenance system.

Due to the life-support nature of diving, personnel involved in the operation, maintenance, and repair of diving systems and equipment shall have appropriate training and experience in the type of equipment used.

The Diving Supervisor shall ensure that all diving systems and equipment have been examined and tested to the extent necessary to determine its condition and suitability for service. No diving operation shall be permitted to commence until all systems and equipment have been thoroughly tested for proper functionality. Equipment designated as "necessary" must be able to continue operating in the event of loss of primary power by the use of batteries, stored energy (hydraulic or air power), connection to an emergency generator, etc.

The ROV Supervisor shall ensure that all ROV systems and associated equipment have been examined and tested to the extent necessary to determine their condition and suitability for service as required.

#### 5.1.2 Maintenance Records

1. Suitable equipment logs shall be established and maintained in a correct and current condition.
2. All equipment shall have a unique identity traceable to the equipment log.
3. Entries made in the equipment log shall describe the nature of the work performed, including the dates of modification, repair or test, the name of the individual performing the work or test, and the particular piece of equipment involved.
4. Individual persons performing maintenance, repair, calibration, test, or modification of any diving equipment shall both print and sign their name in the equipment log.



5. Each diving helmet or mask used in the conduct of commercial diving operations shall be inspected and maintained in accordance with the manufacturer's suggested procedure. Required inspections and/or tests shall be logged and verified in the logbook of the owner of the device.

## **5.2 DIVER'S DRESS**

### **5.2.1 General**

Diver's dress shall be suitable for the job intended and consider such factors as biological, radiological, chemical, and thermal conditions.

### **5.2.2 Dry Suits**

Dry suits shall:

1. If fitted with valves, have a means of preventing overinflation which could result in an uncontrolled ascent.
2. Be constructed of material suitable to the environment in which it is to be used.
3. Protect the diver from the environment, whether temperature or hazardous material.

### **5.2.3 Hot Water Suits**

Hot water suits shall:

1. Flow sufficient water to maintain the diver(s) in thermal balance at the desired temperature.
2. Be capable of withstanding an operating temperature of 110°F (44°C).
3. Have a means to allow the diver to bypass incoming water prior to it entering the suit.
4. If diving in extreme environments, have a back-up hot water supply or, alternatively immediately terminate the dive and bring the diver to the surface if hot water supply is lost.

### **5.2.4 Harnesses**

Harnesses shall:

1. Be made of material of suitable strength to lift the diver and his equipment from the water.
2. Have a mechanical quick release between the harness and the umbilical.
3. Be constructed and fitted to prevent an unconscious diver from slipping free of the harness, or from a strain being placed on mask or helmet.
4. Not be used as a weight belt.
5. Be designed to prevent restriction of the diver's breathing when his or her full weight is supported by the harness.

### **5.2.5 Weight Belts**

Weight belts shall:

1. Be of sufficient weight to maintain the diver at working depth.
2. Not be used as an attachment for the diving umbilical.

3. Be equipped with an appropriate release buckle.
4. Be attached to the diver in a manner to avoid accidental disengagement.

### 5.2.6 Bailout Systems

Bail out systems shall:

1. Have a cylinder meeting the requirements of Paragraph 5.10.3.
2. Have a regulator on the cylinder capable of delivering the proper pressure and flow to the diver's helmet or mask in accordance with the flow characteristics recommended by the helmet or mask manufacturer.
3. Have a means of attachment to the hat or mask which prevents accidental disengagement.
4. Be of sufficient capacity to permit return of the diver to the surface or to the diving bell at a travel rate of 33 feet (10 m) per minute.
5. Be charged with an appropriate breathing gas mixture to accommodate mode of diving/depth requirements.

## 5.3 HELMETS AND MASKS

### 5.3.1 General

Helmets and masks and their associated diver-carried regulators are components of a critical life support system that, if not functioning properly, can expose the diver to significant hazard. As such, all helmets and masks and their associated diver-carried regulators shall be maintained and inspected in strict compliance with the manufacturer's recommendations. Suitable logs shall be maintained to reflect compliance. The owner of helmets, masks, and their associated diver-carried regulators shall be responsible to ensure that these life support critical elements are functioning properly prior to the commencement of each and every dive.

Helmets and masks used for surface supplied diving operations shall:

1. Be appropriate for the task intended.
2. Be capable of ventilating the required (ACFM) of gas when supplied at the pressure recommended by the manufacturer of the equipment at any depth at which they are operated.  
**NOTE: In all cases, the minimum required ventilation rate in ACFM must be in accordance with the manufacturer's design recommendations.**
  - Some large volume helmets without an oral nasal mask may require over 6.0 ACFM
  - Some helmets equipped with an oral nasal mask may require as little as 3.2 ACFM
3. Be capable of maintaining the diver's inspired carbon dioxide partial pressure below 0.02 ATA when the diver is producing carbon dioxide at the rate of 1.6 standard liters per minute.
4. Be fitted with a two-way audio communications system.
5. Be equipped with a non-return valve in the main gas supply which closes readily and positively.



6. Have check valves with springs not exceeding 3 psi cracking pressure.
7. Be made of corrosion-resistant materials.
8. Be protected from overpressurization.
9. Be maintained in accordance with manufacturer's specifications, and have all modifications which affect safety or performance documented in the equipment log.

### **5.3.2 Heavyweight Diving Helmets**

Helmets designated as a heavyweight diving outfit (heavy gear) shall:

1. Meet requirements of Paragraph 5.3.1 above.
2. Have a helmet group consisting of a helmet, breastplate, and associated valves and connections.
3. Be equipped with a quick-dump valve to prevent overinflation.

### **5.3.3 Lightweight Diving Helmets**

Lightweight diving helmets shall:

1. Meet requirements of Paragraph 5.3.1 above.
2. Be fitted to accept a bailout bottle supply.
3. Be fitted to allow for positive and ready removal from the diver in all uses.

### **5.3.4 Closed Circuit and Gas Reclaim System Helmets**

Closed circuit and gas reclaim helmets shall:

1. Meet general requirements of Paragraph 5.3.3.
2. Be fitted to function on open circuit.

### **5.3.5 BIBS (Built-In Breathing Systems)**

Individual breathing equipment utilized in PVHO built-in breathing systems (BIBS) shall:

1. Be suitable for purpose and cleaned for use with oxygen.
2. Be held in place by adjustable straps, hood, or other suitable means that frees the diver's hands.
3. Be capable of providing 2.0 ACFM at maximum depth.
4. Be equipped to allow user to adjust for ease of breathing or constant free flow.
5. Be equipped with an exhaust valve.
6. Be equipped to prevent overpressurization or rapid negative pressure from endangering the user.
7. Be maintained in accordance with manufacturer's specifications.
8. Mask/breathing device should be disinfected prior to each use.

### **5.3.6 Specialized Application Helmets**

Helmets and masks used for specialized applications shall:

1. Meet requirements of Paragraph 5.3.1.
2. Be inspected for deterioration prior to and after extended use in applications where elements of destructive and varied environments are known to exist (i.e., contaminated water, underwater burning, or welding).
3. Be equipped to prevent entry of contaminants to the diver.

## 5.4 HOSES

### 5.4.1 General

Flexible hoses used with diving systems or equipment shall:

1. Have a minimum burst pressure equal to four times the Maximum Allowable Working Pressure (M.A.W.P.).
2. Have a M.A.W.P. and flow rating not less than the system in which it is installed or used and be suitable for the service intended.
3. Have connectors with pressure capability equal to or greater than the hose on which they are installed.
4. Have fittings of corrosion-resistant material that cannot be accidentally disengaged.
5. Be kink resistant or arranged to prevent kinking.
6. Have a suitable temperature rating when used for hot water service.
7. Be subjected to annual visual examination and pressure test to one and one half times design working pressure of the hose assembly for ten minutes without loss of pressure (when corrected for temperature).
8. Be visually examined and pressure tested after each repair or alteration.

### 5.4.2 Breathing Gas Hoses

Breathing gas hose assemblies shall:

1. Meet requirements of Paragraph 5.4.1.
2. Be suitable for breathing gas service.
3. Have a maximum allowable working pressure equal to or greater than maximum depth of dive relative to supply source plus 150 psi.
4. Be subjected to an annual hydro test to one and a half times the design working pressure with a 200-lb. axial load applied on fittings while initial test pressure is applied. The test pressure should be maintained without loss of pressure (when corrected for temperature) for ten minutes to check for creep of end fittings.  
**Note: the axial load weight may be removed after the initial test pressure has been applied providing no leakage is evident.**
5. Be of suitable design to prevent collapse when used for operation with higher external pressure than internal pressure.



### 5.4.3 Umbilicals

Diver umbilicals and dive hose assemblies shall:

1. Meet the requirements of Paragraph 5.4.1.
2. Be marked from the diver/bell end in 10-foot intervals up to 100 feet and marked in 50-foot intervals thereafter.

**Note: To ensure uniformity throughout the commercial diving industry, ADC Standard 006 recommends the following color coding be used by all participants:**

10 feet [3.05 m]	one white band
20 feet [6.10 m]	two white bands
30 feet [9.15 m]	three white bands
40 feet [12.2 m]	four white bands
50 feet [15.25 m]	one yellow band
60 feet [18.29 m]	1 yellow/1 white
70 feet [21.34 m]	1 yellow/2 white
80 feet [24.39 m]	1 yellow/3 white
90 feet [27.44 m]	1 yellow/4 white
100 feet [30.49 m]	1 red band
150 feet [45.73 m]	1 red/1 yellow
200 feet [60.98 m]	2 red bands
250 feet [76.22 m]	2 red/1 yellow
300 feet [91.46 m]	3 red bands

For each 50 feet (15.25 m) thereafter the sequence continues by increasing the number of red bands at each even increment of 100 feet (30.49 m).

3. Be marked with a unique identity and be subjected to a planned maintenance program.
4. Consist of a breathing gas hose, communications cable, a means of determining the diver's depth, and an included strength member.
5. Have strength members made of material unaffected by immersion in water for extended periods.
6. Have a minimum break strength of the hose assembly, including terminating hardware, of 1,000 lbs.

**The umbilical assembly used for the standby diver must be of sufficient length to reach the primary diver at the furthest distance he can proceed from the dive station.**

**Care must be taken to ensure that where known hazards such as propellers (including those of ROV's) or intakes are present in the diving zone that the diver umbilical cannot be drawn into the same. To that end, umbilicals shall be carefully tended to maintain the diver clear of such hazards.**

### 5.4.4 Oxygen Hoses

1. Oxygen hoses shall meet the requirements of Paragraphs 5.4.1 and 5.4.2.
2. Hose assemblies used in systems containing greater than 40% oxygen are to be cleaned for oxygen service.



3. Hoses used for oxygen service shall be identified by a consistent color code or tagged "FOR OXYGEN USE ONLY."
4. Lubricants used to assemble fittings on hoses for oxygen service shall be compatible with oxygen.

## 5.5 COMPRESSOR SYSTEMS

### 5.5.1 Compressors and Gas Pumps

Compressors, boosters, gas transfer pumps, and filters used to provide breathing air/gas for diving shall be designed and manufactured to:

1. Have suitable personnel protection around rotating machinery that meets OSHA standard for rotating machinery (29 CFR 1910.219), as well as applicable jurisdictional requirements.
2. Have the necessary instrumentation to facilitate operations.
3. Be of the proper type, pressure, and flow rate, and be suitable for service intended.
4. Have its air intake arranged to be clear of exhaust fumes and other contaminants.
5. Have piping in accordance with ANSI code B31.1.
6. Have flexible hoses in accordance with **Paragraph 5.4, "Hoses,"** of this section.
7. Have electrical controls, wiring, and drive units meeting the jurisdictional requirements, when so equipped.
8. Not be used to pump or transfer oxygen unless designed for oxygen service.
9. Be cleaned for oxygen service when used with mixtures of greater than 40% oxygen and equipped using rising stem type valves.
10. Be easily accessible to diving personnel, both for routine maintenance and in an emergency.

### 5.5.2 Recording of Maintenance and Repairs

1. Entries shall be made in the equipment log for all maintenance and repairs performed on the compressor and gas system.

**Note: Entries shall include items like belt or oil changes on the compressor.**

2. Results of air quality tests shall be retained by each company in a manner suitable to document their results and accomplishment.
3. Compressors shall have a unique identity incorporating manufacturer, model, serial number, maximum rated outlet pressure, rated flow capacity, and safety valve settings.
4. Compressor units shall be subjected to planned maintenance.

### 5.5.3 Volume Tanks

Volume tanks or receivers used on compressor or breathing gas systems shall be in accordance with **Paragraph 5.10, "Compressed Gas Equipment,"** of this section.



#### **5.5.4 Filtration**

Filters, when installed to prevent contamination, must meet or exceed the flow rate and pressure rating of the compressor or piping system in which they are installed and be able to deliver breathing gas in compliance with Compressed Gas Association (or equivalent) purity standards for extended operation.

#### **5.5.5 Testing**

Compressors used for breathing gas shall be functionally tested per the following schedule, and shall conform to design specifications and the air quality requirement of Paragraph 5.5.6.

1. Prior to being put into service.
2. Periodically in accordance with manufacturer's recommendations and planned maintenance schedule.
3. During annual inspection.
4. After any repairs which may affect compressor performance.

#### **5.5.6 Air Purity Requirements**

1. All compressors, transfer pumps, or booster pumps used for breathing air service will be subjected to a quality test every six months. Compressors with a discharge pressure of 500 psi or less shall meet the standards of ANSI CGA 7.1 - 1989 for Grade D air, as a minimum, and shall contain a maximum of 25 ppm of total hydrocarbon content (as methane). Compressors with a discharge pressure which exceeds 500 psi shall meet the requirements of ANSI CGA 7.1-1989 for Grade E air.
2. Tests in accordance with CGA shall be taken at the discharge point which would normally supply the breathing gas system, the diver's hose, or cylinder fill point.
3. Documentation of these tests shall be kept on file and available upon request.
4. Compressors used for breathing gas transfer other than atmospheric air shall be checked every six months to ensure they do not induce contaminants into the gas being processed.

### **5.6 DIVER ENTRY AND EGRESS SYSTEMS**

#### **5.6.1 Diving Ladder and Stage**

Diving ladders and stages shall:

1. Be capable of supporting the weight of two divers plus their gear.
2. Be made of corrosion-resistant material or be maintained free of corrosion.
3. Be suitable for the purpose intended.
4. Ladders must extend a minimum of three feet below surface where installed.
5. Be provided with a safety chain and internal hand holds for dive safety during launch and recovery. (Stages)
6. Make provisions for mounting of breathing gas cylinder and regulator for emergency breathing at all depths of intended operation. (Stages)

### 5.6.2 Open Bottom Bells (Class II)

Open bottom bells shall:

1. Have an upper section that provides an envelope capable of maintaining a bubble of breathing mixture for a diver when standing on the lower section with his body through the open bottom and his head in the bubble.
2. Have lifting equipment capable of returning the occupied open bell to the dive location.
3. Have an umbilical consisting of breathing gas hose, pneumofathometer, and communications cable attached in such a manner to furnish a strain relief fitting so that individual umbilical components are not subject to load.
4. Be protected against and maintained free from injurious corrosion.
5. Should be able to carry at least two divers in an un-cramped position.
6. Should be fitted with internal handholds for divers.
7. Should be fitted with sufficient internal lighting to allow bell occupant(s) to see and operate controls.
8. Make provisions for mounting of breathing gas cylinder and regulator for emergency breathing at all depths of intended operation. (Stages)

## 5.7 PRESSURE VESSELS FOR HUMAN OCCUPANCY — CHAMBERS

### 5.7.1 Diving Pressure Vessels

The following are minimum requirements for PVHO's:

1. Equipment shall be built in accordance with United States Coast Guard Regulations, ASME/PVHO-1, and/or a Classing Society Competent in PVHO Diving Systems and shall be subject to a Planned Maintenance System.
2. Each pressure vessel, including each volume tank, cylinder, PVHO, and pressure vessel piping, shall be examined and tested annually for mechanical damage or deterioration and shall likewise be examined and tested after any repair, modification, or alteration.
3. The following tests shall be conducted at least every three years:
  - a. All piping permanently installed on a PVHO shall be pressure tested.
  - b. PVHO's subject to internal pressure shall be leak tested at the maximum allowable working pressure using the breathing mixture normally used in service.
  - c. Equivalent non destructive testing may be conducted in lieu of pressure testing. Proposals to use non-destructive testing in lieu of pressure testing shall be submitted to the USCG Officer in Charge, Marine Inspection or appropriate national authority.
4. Unless otherwise noted, pressure tests conducted in accordance with this section shall be either hydrostatic tests or pneumatic tests.
  - a. When a hydrostatic test is conducted on a pressure vessel, the test pressure shall be no less than one and one quarter times the maximum allowable working pressure.
  - b. When a pneumatic test is conducted on a pressure vessel, the test pressure shall be the maximum stamped on the nameplate.



- c. When a pneumatic test is conducted on piping, the test pressure shall be no less than 90% of the setting of the relief device.
- d. Pressure tests shall be conducted only after suitable precautions are taken to protect personnel and equipment.
- e. When pressure tests are conducted on pressure vessels or pressure piping, the test pressure shall be maintained for a period of time sufficient to allow examination of all joints, connections, and high-stress areas.

### 5.7.2 Decompression Chambers

Decompression chambers shall:

1. Meet requirements of Paragraph 5.7.1.
2. Be dual lock and multiplace (except emergency rescue chambers or chambers designed to mate with another PVHO).
3. Have sufficient internal dimensions to accommodate a person lying in a horizontal position with another person attending (except designated diving bells, transfer locks, and emergency rescue chambers).
4. Permit ingress and egress of personnel and equipment while the occupants remain pressurized.
5. Have a means of operating all installed man-way locking devices, except disabled shipping dogs, from both sides of a closed hatch.
6. Have illumination of the interior sufficient to allow operation of any controls and allow for visual observation, diagnosis, and/or medical treatment.
7. Have a visual capability that allows the interior to be observed from the exterior.
8. Have a minimum pressure capability of 6 ATA (165 fsw) [50.3 m]; or the maximum depth of the dive for dives deeper than 10 ATA (300 fsw) [91.5 m].
9. Be capable of a minimum pressurization rate of 60 fsw (18.3 m) and at least 30 fsw (9.2 m) per minute thereafter.
10. Be capable of a decompression rate of 30 fsw (9.2 m) per minute to 33 fsw [10.06 m].
11. Have a means to maintain an atmosphere below a level of 25% oxygen by volume.
12. Have a means of maintaining an atmosphere below 2% surface equivalent carbon dioxide by volume.
13. Have mufflers/silencers on blowdown and exhaust outlets.
14. Have suction guards on exhaust line openings inside each compartment.
15. Have piping arranged to ensure adequate circulation.
16. Have all installed flexible hoses meet the requirements of **Paragraph 5.4, “Hoses.”**
17. Have all penetrations clearly marked as to service.

18. Have piping in accordance with ANSI Code B3 1.1, and/or ASME/PVHO 1990 or Classification Society to which it was built.
19. Have a dedicated pressure gauge indicating depth for each pressurized compartment.
  - have a calibration of each depth gauge within six months.
  - be arranged so as to allow comparison with another gauge while in operation.
20. Have a pressure relief device as per ASME/PVHO-1 or the code of construction.
21. Have the relief valve pressure setting tested annually and the test recorded in equipment log.
22. Have an installed breathing system with a minimum of one mask per occupant per lock plus one spare mask per lock.
23. Have the capability to supply breathing mixtures at the maximum rate required by each occupant doing heavy work (4.5 ACFM).
24. Have a non-return valve on through hull penetrators supplying any built-in breathing system (BIBS).
25. Have a two-way voice communication system between the occupants and the operator, also between other occupants in separate compartments of the same PVHO or an attached PVHO. This may be a sound-powered phone system.
26. Have a speech unscrambler when used with mixed gas.
27. Be equipped with a readily available means for extinguishing fire.
28. When fitted, have electrical systems designed for the environment in which they will operate.
29. Chamber exhaust should not vent into an enclosed space.
30. The chamber, its general area and controls should be adequately illuminated for operations at night.
31. If external lights are used to illuminate the chamber internally, they shall not be placed in a manner to subject viewports to heat buildup.
32. If the chamber is located away from the dive control station there must be a suitable means of communications between the two locations.
33. There shall be one BIBS mask for each occupant plus a spare.
34. A means should be available to analyze the O<sub>2</sub> and CO<sub>2</sub> content of the ambient atmosphere of each chamber compartment. They may be accomplished using chemical tubes for the CO<sub>2</sub> content analysis.

### 5.7.3 Diving Bells (Class 1)

Submersible decompression chambers/diving bells shall:

1. Meet the requirements of Paragraph 5.7.1.
2. Have sufficient internal dimension to accommodate the intended number of divers and their equipment.



3. Have protection against mechanical damage to valves penetrators, sealing surfaces, onboard gas, etc.
4. Have view ports to allow occupants to observe their external surroundings, also sufficient to allow observation of the interior from the exterior.
5. Have protection against mechanical damage on all view ports.
6. Have all piping penetrations equipped with a shutoff valve on both sides of the pressure boundary.
7. Have all penetrations, valves, gauges, and piping clearly marked as to service and operation. A diagram or photographic records of the bell valves (internal and external) should be available at the dive control station.
8. Have all installed flexible hoses meet the requirements of **Paragraph 5.4, “Hoses.”**
9. Be equipped with sufficient lighting to allow occupants to distinguish and operate controls at all times.
10. Have an installed oxygen analyzer readable by the occupants.
11. Have a method of analyzing CO<sub>2</sub>.
12. Have a means of removing CO<sub>2</sub>.
13. Have a means by which occupants may read internal depth pressure and external depth pressure.
14. Have a primary two-way radio communication system between the diving supervisor and all divers supported from the bell, including the bell attendant.
15. Have a secondary communication system connected to the operator station.
16. Be equipped with an acoustical beacon operating at 37.5 KHz.
17. Have interior electrical systems which are designed for the environment in which they will operate to minimize the risk of fire, electrical shock, or galvanic action of the PVHO.
18. Have electrical penetrators which are tested to a minimum of two times design pressure of the bell and capable of withstanding applied pressure in either direction.
19. Have a capability of removing an injured diver from the water.
20. Have an identified secondary lift point capable of supporting the submerged weight of the bell.
21. Have a bell heater or other means of maintaining a physiologically suitable temperature during normal operations.
22. When so equipped, have a means of controlling hot water flow to a diver locked out of the bell.

23. Have gas piping arranged so that a venting or flushing of the bell will not adversely affect the breathing gas supply of any divers supported from the bell.
24. Be equipped with one individual breathing device for each occupant capable of providing breathing gas both from a surface supplied source and the onboard emergency gas.
25. Have sufficient onboard gas to allow a diver to remain outside the bell for 30 minutes at the maximum depth rating of the bell, at a breathing rate of 1.5 cfm.
26. Have a gauge indicating the pressure in the onboard emergency gas cylinders, readable by the bell occupants.
27. Have metabolic oxygen onboard to support the number of occupants for a period of 24 hours at a consumption rate of at least 0.5 liters, per occupant.

**Note: Mixed gas in sufficient quantity may be substituted.**

28. Have an oxygen supply so arranged that oxygen flow into the bell is limited to a controlled rate or volume relative to the bell internal pressure.
29. Have a first aid kit in a clearly marked and suitable container.
30. Have a basic tool kit.
31. Have a water-resistant copy of emergency procedures.
32. Have umbilicals that meets the requirements of **Paragraph 5.4, "Hoses,"** 5.4.1 – 5.4.4, and provides: breathing gas, pressurization and exhaust, communications and power, hot water, and other required services. The bell standby divers' umbilical must be capable of quick release action by the bellman once he is out of the bell in an emergency. If the bell standby diver's umbilical is stored outside of the bell it must be adequately stowed to avoid damage during launch and recovery of the bell. The end of the bell standby divers' umbilical must be arranged to allow the standby diver to attach his mask or helmet and test it before the main diver exits the bell.
33. When fitted, have ballast release mechanisms that are designed to prevent accidental release.
34. A design such that the diver can freely exit and re-enter the bell if it is resting on the seabed. This normally requires a standoff frame.
35. If diving below 500 fsw (152 meters) there must be a means of heating the divers' inspired gas.
36. Have a copy of the emergency tap code available to the bell occupants and dive control station personnel.

#### **5.7.4 Hyperbaric Evacuation Systems**

There are three types of hyperbaric evacuation systems (HES).

1. A diving bell adapted for evacuation use.
2. A PVHO adapted for use in an evacuation. This may be designated for lift off and/or free floating.



3. A dedicated rescue system where a pressure chamber is fitted into or forms a part of a purpose built lifeboat.

#### **5.7.5 Hyperbaric Evacuation Systems shall:**

1. Meet the requirements of 5.1.1.
2. Be outfitted to accommodate the maximum number of divers who may be under pressure.
3. Be fitted with a locating device to assist rescuers in locating it.
4. Have metabolic oxygen on board to support the number of occupants for a period of 24 hours at a consumption rate of .017 cfm per occupant. Note: mixed gas in sufficient quantities may be substituted.
5. Have a suitable means to remove carbon dioxide from the atmosphere.
6. Have a suitable First Aid kit clearly marked, in a suitable container, and accessible.
7. There must be a detailed written procedure for launching the HES contained in Emergency Procedures.

### **5.8 GAUGES**

Gauges utilized with diving equipment or systems shall:

1. Be suitable for purpose intended.
2. Be cleaned for oxygen when installed in oxygen systems.
3. When used to indicate a diver's depth:
  - Be of appropriate range and graduation.
  - Be graduated in units consistent with the decompression tables to be utilized.
  - Be calibrated to a known standard every six months.
  - Be recalibrated when a discrepancy exists exceeding 2% of full scale.
  - Be marked with a label, tag, or sticker indicating date of last calibration and date due, which will not interfere with full scale visibility.
  - Have a tag or label indicating amount of deviation (+ / -) to the calibration standard.
  - Have calibrations documented in the equipment log.
  - A pressure-limiting device may be fitted to avoid gauges being over-pressurized.

### **5.9 TIMEKEEPING DEVICES**

Devices utilized to monitor a diver's exposure time under pressure shall:

1. Be suitable for purpose and easily readable.
2. Be compared against a known standard every six months.
3. Have test dates recorded in an equipment log or in some other suitable and retrievable manner.
4. Not be used when an error exceeding one quarter of one minute in four hours exists.



## 5.10 COMPRESSED GAS EQUIPMENT

### 5.10.1 Volume Tanks / Air Receivers

Volume tanks used in diving systems shall:

1. Be designed, fabricated, inspected, tested, and certified in accordance with American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code Section VIII, Div. I "Unfired Pressure Vessels," and/or other statutory or classification society requirements.
2. Be equipped with a pressure gauge.
3. Be equipped with a check valve on the inlet side.
4. Be equipped with a relief valve as required by code of manufacturer.
5. Be equipped with condensate drain valve, located at its lowest point.
6. Be equipped with slow opening valves when used with design pressures exceeding 500 psi.
7. Be cleaned for oxygen service and have slow opening valves when used in systems containing greater than 40% oxygen.
8. Be inspected internally and externally at least annually for damage or corrosion.
9. Be pneumatically tested to M.A.W.P. annually utilizing the breathing mixture normally used.
10. Be hydrotested to 1.5 M.A.W.P. every fifth year or after any repair, modification, or alteration to the pressure boundary and stamped with the test date.
11. Have a unique identity with results of all tests being recorded in the equipment log.

### 5.10.2 Gas Storage Cylinders and Tubes

High pressure gas cylinders or tubes shall:

1. Be manufactured to recognized code or standard.
2. Be equipped with an overpressure relief device.
3. Be visually examined annually for damage or corrosion.
4. If rack mounted into banks of cylinders or tubes, have valves and regulators protected from damage caused by impact or from falling objects.
5. Be hydrostatically tested to one and a half times M.A.W.P. or code requirements every five years and stamped with the test date.
6. Be inspected internally and externally at least annually for damage or corrosion if used underwater.
7. Be labeled as to contents. Fire hazard warning signs should be erected in the vicinity of stored oxygen.
8. Be stored in a well-ventilated area, protected from overheating, and secured from falling. Fire warning signs should be erected in the vicinity of stored oxygen.



9. A record should be kept in a designated place of the contents and pressure of each cylinder, quad, or bank. These records should be updated daily when the system is in use.

### **5.10.3 Scuba and Bailout Bottles**

High pressure bottles used for scuba and bailout shall:

1. Be manufactured to recognized codes or standards.
2. Be equipped with an overpressure relief device.
3. Be inspected internally and externally at least annually for damage or corrosion.
4. Be hydrostatically tested every fifth year to the requirements of the code of manufacturer by an authorized test facility and stamped with the date of test.
5. Have a unique identity with results of all tests being recorded in the equipment log.

## **SECTION 6.0**

# **REMOTE OPERATED VEHICLES (ROV's)**





## 6.0 REMOTE OPERATED VEHICLES (ROV's)

### 6.1 INTRODUCTION

The purpose of guidance contained in this section is directed to the use of ROV's within the commercial diving and underwater industry and to provide general material intended to contribute to the highest possible degree of safety during the conduct of ROV operations.

With the passage of time the use of ROV's has become more prevalent and important to the conduct of underwater tasks whether offshore, inland, or in the coastal zones. Additional capabilities are being added to this method of operation as technology continues to improve and additional sensors or tools are developed for deployment in the underwater working environment.

Coupled to an improvement of the capabilities of the remotely operated vehicle has been a necessity to better train and prepare ROV Pilot Technicians to be able to accomplish the intended operation in an efficient and safe manner. As the ROV's become more sophisticated and able to serve as the platform for sophisticated sensing, recording, and tool devices, so too does the requirement become more evident that the personnel engaged become more skilled in their ability to maintain and operate the vehicles. Associated with this is the obvious necessity that as ROV operations continue to grow and employ greater numbers of personnel, considerations related to safety must go hand in hand with that growth.

### 6.2 BACKGROUND

Implementation of these guidelines will vary dependent upon the class of ROV used and it is important to recognize that the great diversity and variety of vehicles make it difficult to definitively state into which class a particular ROV may fall.

The term remotely operated vehicle (ROV) covers a wide range of equipment with no single vehicle able to be described as typical. Not only are there numerous differences between basic design, but the same basic ROV can be modified to carry out different tasks. For the purpose of this standard, five different classifications are identified but it should be recognized that there can be subdivisions within these classes. For example, ROV's launched and recovered in a "garage" or "cage" with a tether management system may be subdivided from those that are free swimming. Likewise, a large work-class ROV may be tracked just as a small observation vehicle can be mounted to tracks for specialized operations in the observation mode.

#### 6.2.1 Classification System

- **Class 1 – Pure Observation.** Pure observation vehicles are generally considered to be physically limited to video observation and fitted with a video camera, lights, and thrusters. However, this is not a fixed "rule" and these types of vehicles have evolved to have an ability to perform other tasks if properly fitted with additional sensing devices.
- **Class II – Observation with Payload Option.** These vehicles are generally somewhat larger than those of a pure observation nature and are capable of carrying additional sensors such as still cameras, cathodic potential measurement devices, additional video cameras, sonar systems, and small manipulators. Class II vehicles should be capable of operating without loss of original function while carrying at least two additional sensors.
- **Class III – Work Class Vehicles.** These vehicles are large enough to carry additional sensors and/or manipulators and commonly have a multiplexing capability to allow additional sensors and tools to operate without being "hard-wired" through the umbilical system. These vehicles are generally larger and more powerful than Classes I and II. Wide variations of power, depth rating, and capability are possible.



- **Class IV – Towed or Tracked Vehicles.** Towed vehicles may be pulled through the water by a surface craft or winch. Some may have limited propulsion power for limited maneuverability.
  - a. Tracked vehicles have an ability to move across the bottom. Some may have a limited mid-water column “swimming” capability.
  - b. Vehicles within this class may derive from those of Classes I through III and thus, their physical attributes may vary widely.
- **Class V – Prototype or Development Vehicles.** Vehicles in this class include those under development, or special purpose vehicles that do not fit within one of the other classes.

### 6.2.2 ROV Tasks

ROV capabilities are constantly being expanded as technology improves. Introduction of enhanced specification vehicles and the upgrading of existing systems produce a wider and more efficient family of ROV's. It is thereby not possible to detail all the tasks for which an ROV may be employed.

For each operation, the ROV contractor should be satisfied that the vehicle system and equipment provided are fit for the intended purpose. Suitability can be assessed only by proper planning and assessment conducted by a qualified individual, by physical testing, or by previous employment in similar circumstances.

- **Observation.** Observation is the least complicated work mode. It can normally be undertaken by the use of a video camera without additional equipment and is generally conducted by ROV's of the Class I or Class II variety. If monitoring divers is entailed the vehicle will normally be maintained in a near stationary position.
- **Survey.** Surveying activity normally consists of some form of observation of the intended area of operations whether on the seabed or within an enclosed area such as a pipeline, outfall, or tank-like structure. Survey can also be employed as a post construction or equipment installation verification tool. The general purposes of surveying activity may be:
  - a. Fixing geographical coordinates
  - b. Ensuring the target structure or device is within a permitted corridor or area
  - c. Verification of burial
  - d. Determination of physical damage
  - e. Examination of pipelines or structures
  - f. Verification of debris removal
  - g. Identification
- **Inspection.** It is often difficult to distinguish between inspection and survey, particularly as an ROV may carry out both types of tasks in a single dive. Inspection tasks usually concentrate on specific, pre-defined areas of concern and include detailed visual and/or other types of inspection using on-board sensors such as cathodic protection measurement devices.
- **Construction.** These tasks normally require a larger vehicle capable of deployment of at least one manipulator. Construction vehicles may be employed in such tasks as removal of debris, intervention, connection or removal of lifting devices, or actuation of valve components.
- **Intervention.** Many work-class ROV's have specially designed tool packages able to interface with subsea manifolds, wellheads, or control pods to effect installation, removal, maintenance, or repair functions.

### 6.2.3 ROV Tools

Tool packages can be varied to suit requirements with new devices being constantly developed and upgraded. This section furnishes a brief introduction to some of the more common tools.

When installing or using ROV tools all relevant manufacturer and industry safety instructions should be applied. Just as with any other piece of equipment, an appropriate maintenance log should be preserved.

When operating ROV's in areas where considerable current or surge may be present planning and assessment techniques should be employed to ensure that the mounted tools will not create a hazard to either personnel or the vehicle.

- **Cameras.** Cameras can be mounted in a fixed position, on a pan and tilt assembly, or held by a manipulator. Video systems with the ability to view in conditions of low light intensity and still cameras to furnish high-resolution documentation are available. Pan and tilt assemblies furnish a capability to allow training of the camera system to permit omni-directional viewing.
- **NDT Sensors.** The more commonly used sensors for NDT activity are cathodic potential (CP) probes, ultrasonic thickness measurement devices, and flooded member detection systems.
- **Acoustic and Tracking.** Numerous acoustic systems are available such as tracking and measurement devices, scanning, profiling, side-scan, sub-bottom profiling, bathymetric, and pipe tracking.
- **Cleaning.** ROV's can be used as a platform for cleaning devices used for structures and/or vessels. These devices can range from simple rotary wire or nylon brush systems to more sophisticated units capable of removing calciferous marine growth.
- **Station Keeping.** Many ROV's are capable of maintaining heading, depth, and position. Attachment devices are available to permit the ROV to be located in a virtually fixed location. Some of these devices are:
  - a. Docking cones and similar stabbing devices
  - b. Suction pads and water pumps for hydrostatic attachment on smooth surfaces
  - c. Manipulator-mounted hydraulic devices to grip structural members

**Note: Attachment devices should be fitted with a "fail-safe" feature to permit disengagement if power to the vehicle should fail.**

### 6.2.4 Environmental Considerations

To ensure safety and efficiency of the intended operation it is necessary to take into consideration both the probable and unanticipated environmental considerations of the intended work site.

For any given situation a combination of conditions can be dramatically different. It is necessary to consider these factors during the planning and assessment phase, and then it becomes the responsibility of the ROV Supervisor to assess all available information before deciding to conduct the ROV operation.

- **Water Conditions.** ROV's can operate from very shallow to depths in excess of several thousand meters. Increased depth capabilities are being achieved as the need develops for the conduct of deeper operations. Individual ROV's should not be used below their design depth. When operating ROV's, consideration should be given to:
  - Umbilical length and associated drag. These influence the specification of the topside handling system.
  - Transit Time. Crew members assigned to monitoring the ROV may become distracted during a long transit with the ROV at extreme depths.

Variations in temperature, salinity, depth, and acoustic noise should be considered for their possible adverse affects on acoustic tracking and positioning systems. Water characteristics



may also have an effect. The following factors should be taken into account when assessing the use of a vehicle for a given task:

- Visibility – Poor visibility can adversely affect an operation and may require the use of sophisticated equipment such as acoustic imaging systems. Vehicle operation near the seabed may stir up fine-grained sediment that remains in suspension to reduce visibility in low or zero current conditions.
- Temperature – Extreme temperatures (both high and low) may affect the reliability of electronics and cause material fracture that leads to structural or mechanical damage – particularly in arctic conditions. Hydraulic oil and lubricants that offer stable properties over the intended temperature range should always be used.
- Salinity – This may vary substantially near river mouths, in tidal estuaries, and near outfalls. The resulting variation in water density may affect ROV buoyancy, trim, and the accuracy of sonar data.
- Pollutants – The presence of petroleum products or other pollutants can cloud optical lenses, damage plastic materials, affect visibility, block sound transmission, or cause a sudden loss of buoyancy. Where pollutants are present, precautions should be taken to protect the in-water portions of vehicles and the topside personnel who handle the ROV during launch, recovery, and maintenance.
- Water movement – ROV's are sensitive to water movement and extra care should be taken in shallow water where surge or thrust from surrounding vessel propellers or thrusters can have an effect on vehicle control.

- **Currents** can create considerable problems in ROV operations but quantitative data on particular current profiles are rarely available.

Simulations and analysis can provide good current prediction, but currents do not remain constant for long, even those close to the seabed. Currents also vary with location and surface currents can be rapidly affected by wind. Tidal meters and historical data are useful indicators of current strength and direction for particular areas and depths.

Factors that may affect ROV operations, including their maneuverability in current, include:

- Length and diameter (mass) of umbilical
- Propulsion power
- Depth and orientation to the direction of the current
- A non-uniform current profile
- Umbilical “strumming” or “spinning” in deep water [this may require the use of specially designed umbilicals]
- Vehicle hydrodynamics [i.e., surface area and profile]

- **Sea State and Swell** can affect every stage of an ROV operation.

Safety must always be carefully considered when launching or recovering an ROV, particularly from a support vessel in rough seas. ROV operators should understand the effect of a heaving support ship on the umbilical attached to a relatively motionless ROV, and should be aware that the ROV handling system can be overloaded or that personnel on deck may be exposed to a risk of accident.

In rough conditions, personnel involved with launch and recovery must wear all necessary personnel protective equipment and fully understand their own role as well as the roles of others involved in the operation. Good communication is vital for avoiding accidents.

In certain situations, deployment systems incorporating motion compensation can either reduce or better accommodate the effect of wave action and thereby permit ROV operations to be conducted in higher than normal sea states while maintaining high safety standards.



- **Weather.** While ROV's themselves are not normally sensitive to weather, the cost and efficiency of ROV operations can be affected in a number of ways:
  - Wind speed and direction can make station keeping difficult for the support vessel and adversely affect ROV deployment and recovery.
  - Rain and fog can reduce surface visibility and create a hazard for the support vessel.
  - Adverse combinations of wind, rain, snow, etc. can make the work of ROV crews hazardous for personnel on deck.
  - Hot weather can affect the ROV electronics and related systems. Likewise, hot weather can have an adverse effect on ROV crew personnel on deck.
 Operations should therefore be carefully monitored with regard to the safety of both personnel and equipment affected by adverse weather conditions.
- **Seabed Characteristics.** When planning an ROV operation, local seabed conditions and topography should be known in advance. Rocky outcroppings or submerged structures can make collision more likely and add to the risk of abrasion of the vehicle umbilical, or affect signal transmission from sonar or other devices.

### 6.2.5 Operational Considerations

In order to assure the safe and efficient use of ROV's, operators should ensure that the chosen ROV system has been satisfactorily tested prior to use and that it is capable of meeting the operational requirements of the job. The ROV Supervisor should commence an operation only after carefully considering:

- System and crew readiness
- The effects of environmental factors anticipated during the operation
- Potential risk factors that may be present during the operation
- The nature and urgency of the intended tasks

All of these plus a variety of other considerations must be made a part of the Job Hazard Analysis conducted during planning and assessment.

The ROV Supervisor should never allow contractual pressure to compromise the safety of personnel during planned or ongoing ROV operations and must at all times be prepared to discontinue operations if safety is imperiled.

- **Operating Procedures.** The operating procedures shall consist, as a minimum, of the ROV contractor's Safe Practices/Operations Manual [company procedures] together with any site-specific requirements and procedures. Contingency procedures for emergency action are also a requirement.

The management chain of command for an ROV project shall be clearly defined and the ROV Supervisor identified in writing. If operations will continue beyond a single shift per day an alternate ROV Supervisor must be designated.

- **Planning and Assessment.** Specific operating procedures necessary for accomplishment of the intended tasks will be largely determined during the planning process. This process is intended to analyze potential hazards, areas of possible job interference, and an assessment of other risks as may be deemed to be possible during the conduct of operations.
- **ROV Systems Location and Integrity.** During the planning and assessment phase consideration must be given to the site from which the ROV operations will be conducted. Dependent upon the project this may be from an offshore platform, vessel, pier, shoreline, small boat, or other site. Considerations that must be factored into the operational plan include, but are not limited to:
  - The type of structure or vessel from which the ROV operations will be conducted and an evaluation of whether there is sufficient working area for the ROV, its associated systems, and the ROV crew members.



- Whether the dive control station is in an area of hazard such as where ignition of gas, vapor, or liquid could cause a fire or explosion.
- Whether surrounding or associated operations can create a hazard either to the ROV, its systems, or crew personnel. Examples of this might be where crane or other associated overhead operations are being conducted.
- The proximity of the ROV to a required handling system with consideration of lateral or horizontal distances that must be traversed in order to launch or fully recover the vehicle.
- **Handling Systems.** Handling systems, whether for ROV's or other uses, can be inherently dangerous if care and attention during their use is not maintained.

Detailed operating procedures for each handling system should be readily available at the job site and ROV operators must be knowledgeable regarding the safe working loads to which that system is limited. When the system is to be secured to a deck by a welding process, non-destructive examination methods should be employed to ensure appropriate integrity of the installation.
- **Testing, and periodic examination.** A procedure should be developed for a responsible person to examine ROV handling systems:
  - at least each six months for physical damage, misalignment, or evidence of wear at critical points,
  - after any major alternation or repair that may affect its integrity, and
  - after having been relocated from one position or site to another.
- **Cables, umbilicals, and associated hardware** should be examined at least each 6 months in accordance with the manufacturer's recommendations and any such regulatory guidance in effect. Appropriate logbooks and records should be maintained.
- **Communications.** Effective and reliable communications are critical to the safety and success of any operation. All personnel involved in the operation shall be fully aware of the work being undertaken and the status of any unusual situation that may or does arise during the work performed.
  - **Diving Operations.** The Diving Supervisor has ultimate responsibility for the safety of the entire operation when diving operations are taking place. Communications must be maintained at all times between the Diving Supervisor and ROV Supervisor.
  - **Vessel Control.** The ROV Supervisor shall ensure and maintain effective communication with vessel movement control personnel whenever ROV operations are in progress.
- **ROV Operating Sites.** ROV's are required to operate from different locations with varying levels of support for the ROV system and crew. Due consideration should be given to the limitations of each location on safety and efficiency. Suitable deck strength, extra supports, external supplies, and ease of launch and recovery should be considered.

Prior to mobilization, the ROV Supervisor should inspect the site and decide on the optimum location for the ROV system. Umbilical or cable runs should be carefully established to protect against physical damage or interference. Additionally, the length and fleet angles for these runs must be evaluated to protect system integrity and functionality.

When considering the use of **vessels of convenience** for support of ROV operations, operational limitations may be encountered. Some of these limitations may relate to:

- Lack of maneuverability
- Lack of navigational accuracy
- Mooring or anchoring systems
- Deck space

- Electrical power reserves
- Propeller guards
- Limited personnel accommodations
- Familiarity with intended type of operations
- Minimal (or excessive) freeboard

When intending to conduct operations from a **fixed platform** there are a number of specific areas of consideration such as:

- A need to comply with specific, often onerous, zoning requirements relating to hydrocarbon safety, or other specific regulations of the operator
- Difficulties of installing surface support equipment
- Training requirements for ROV crew personnel related to platform-oriented operations
- Deployment and recovery complications (including tidal effects) caused by the height difference between the platform deck and waterline
- Hazards created by surrounding activities on the structure

**Anchored, moored, or DP vessel** operating sites present similar hazards as those of the fixed platform variety, although zoning and hydrocarbon safety requirements will normally apply only to drilling rigs.

Where Dynamically Positioned (DP) vessels are to be utilized it must be remembered that the vessel propellers/thrusters are in constant use. Care must be assured that the ROV umbilical does not come into incidence with rotating equipment and that the umbilical will not be adversely affected by thrust or wash from same.

- **Navigation.** The use of acoustic location beacons on some ROV's contribute to navigation, positioning, and tracking. In some cases an ROV can be placed beside a submerged object to establish an accurate position for that object.

In some situations there is a potential danger of acoustic interference, such as shadowing or noise, if several vessels are operating in the same area or if large-scale construction or survey projects are present. This can be a particular problem if the DP vessel relies on acoustic signals for positioning. Frequencies for acoustic beacons should be selected to avoid interference. In larger projects, these tasks of coordination of frequencies employed may necessitate some form of central control.

- **Manuals and Documentation.** To ensure the safe and efficient operation of ROV's appropriate logbooks, checklists, and manuals are required on site. It is the contractor's responsibility to ensure that each ROV Supervisor is supplied with necessary documentation.

Regulations and legislation appropriate to the intended area of operations must also be understood and available at the site of operations.

- **Umbilicals.** Umbilicals can be broadly categorized by their weight and material composition, but vary in strength, power, and signal transmission characteristics.

Lightweight umbilicals are generally reinforced with Kevlar for strength, and use some form of appropriate abrasion-resistant material for jacketing. Medium-weight umbilicals may comprise a jack, a stainless-steel braid, and a Kevlar central member. Heavy-weight, or armored umbilicals, can be used for lifting.

ROV Supervisors and operators should be aware that the umbilical is limited by its breaking load, safe working load, and minimum bend radius.

Periodic and routine inspection and maintenance of umbilicals should be performed in accordance with the manufacturer's design and instructions and re-termination performed as per those instructions.

- **Launch and Recovery.** The ROV Supervisor is responsible to ensure that a safe launch and recovery of the ROV can be performed and that all members of the ROV and support crew understand what is required. These evolutions should progress in a smooth and logical manner with all personnel involved fully aware of the situation at all times.



The ROV handling systems design parameters should furnish calculations to define launch and recovery limitations based on weather, sea state, support vessel motion, and other parameters appropriate to the intended operation.

- **Physical Hazards.** In addition to those discussed above, a number of other physical hazards may be encountered during ROV operations. These include:
  - Intakes/Discharges – ROV's are vulnerable to suction or turbulence caused by water intakes and discharges. The ROV Supervisor should establish the presence of any such intake and discharge locations that may create a hazard and establish procedures to minimize their effect.
  - Diving Operations – When conducting ROV operations in the vicinity of diving operations certain hazards are introduced such as possible entanglement of umbilicals, physical contact, electrical hazards, and the fact that ROV propellers or thrusters can present a hazard. Close liaison between the ROV and Diving Supervisors is required.
    - \* The physical hazards to divers caused by the power, mass, and possible inertia of the ROV should not be underestimated.
    - \* Communication between the ROV and Diving Supervisors must be effective and continuous, and is mandatory. A loss of this communication requires emergency procedures and an immediate stop of the ROV propellers/ thrusters/tracks.
  - Electrical – ROV electrical requirements are significant and able to create hazardous situations if not properly handled. Care must be taken to ensure that all personnel are protected from any electrical hazards at all times, whether during maintenance, pre launch, post launch, or operational conditions.
  - Water Blasting – Some ROV's carry high-pressure water blasting equipment. These systems have been known to cause accidents and fatalities and severe damage to equipment when not used correctly. Care must be taken during testing and operation to prevent accidents both during topside and in-water activity.

### 6.2.6 Personnel

All ROV personnel should be competent to carry out the tasks required of them. The qualifications of ROV personnel are determined by training, experience, and by actual evaluations of the individual by an employer.

The following qualifications are regarded as the normal industry-accepted standards for ROV personnel:

- Appropriate academic qualification for the area of employment
- At least one year of industrial or military experience relevant to their academic training
- A responsible attitude to work. ROV personnel are required to work in a team environment and may be subjected to the pressure of long shifts or long periods of time at sea or away from home
- Work experience recorded in an ROV or company maintained logbook to detail vehicle types, field experience, pilot hours, training, or other appropriate information

More detailed information relating to qualification and training is contained elsewhere in this standard.

Possession of an ADC International ROV Certification Card or other certificate does not, in itself, demonstrate competence for a specific operation or the ability to serve as a pilot or technician on a particular ROV. When assessing the individual, the contractor/employer must satisfy himself that the individual is, in fact, qualified to perform at the required level necessary to the intended operation.

Extensive work experience may substitute for academic qualification, but each case should be treated individually.

Medical fitness of personnel should meet relevant local or national requirements and take into consideration the demands of the intended work. A medical examination should be conducted not less often than every two years.

- **Manning.** Safety of personnel is paramount during operations and maintenance with it being the responsibility of the contractor to provide a skilled team of sufficient numbers to ensure safety at all times. When defining the team size the contractor should consider:
  - Nature of the work being undertaken
  - Deployment method
  - Location
  - Vehicle classification
  - Operational period
  - Ability to respond to emergency requirements

The contractor should provide a sufficient number of properly trained and experienced personnel able to operate all equipment and to provide support function to the ROV team, rather than rely on personnel provided for others to offer assistance (i.e., clients, vessel crews, etc.). For safe operations, the team may also need to include additional deck support personnel and other management or technical support personnel. However, personnel not normally employed by the ROV contractor can create a hazard to themselves and others if they lack familiarity with the contractor's procedures, rules, and equipment. Therefore, their competence and suitability should be carefully considered before their inclusion in the ROV team.

Safe working practice dictates that personnel should not work alone when dealing with:

- High voltage
- Heavy lifts
- High pressure machinery
- Umbilical testing
- Potential fire hazards – welding, burning, etc.
- Chemicals capable of generating toxic fumes



## SECTION 7.0

# DYNAMIC POSITIONED VESSEL DIVING SYSTEMS AND OPERATIONS







## **7.0 DYNAMIC POSITIONED VESSEL DIVING SYSTEMS AND OPERATIONS**

### **7.1 INTRODUCTION**

The purpose of these Guidelines is to incorporate the experience which has been gained in other parts of the world and apply it to the United States. The Association of Diving Contractors International guidelines draw heavily on the experience reflected in the Guidelines issued in 1983 by the U.K. Department of Energy and the Norwegian Petroleum directorate.

These Guidelines relate to and are intended to assist in, the design and operation of dynamically positioned diving support vessels. Their purpose is to provide a basis from which designers, suppliers, builders, vessel owners, diving contractors, masters, diving supervisors, and charterers can develop the most suitable equipment and operating procedures for each vessel and to provide a yardstick against which the suitability of DP vessels for diving operations can be assessed.

Implementation of the Guidelines will vary from vessel to vessel and the characteristics of each vessel will affect its suitability for particular operations. Even in the short term, this may alter in the light of changes in personnel and system components. It is therefore important that the revised Guidelines be used not only by owners in preparing vessels (or diving operations), but also by potential charterer in assessing vessels suitable for their particular needs.

Section II clearly states the three main principles, which relate to the subject and the following three sections contain guidance on the implementation of these principles.

The general conduct of diving operations from dynamically positioned (DP) vessels should follow the same principles as for other diving operations. In addition, no effort should be spared to establish DP operational reliability and to ensure that, if the vessel does lose station, the effects on the divers are minimized. All those connected with the operation should retain this in mind at all times.

### **7.2 PRINCIPLES**

#### **7.2.1 Introduction**

The Guidelines are built around three main and interrelated principles. These are simply stated in this section. The remaining sections contain guidance on their implementation. Though they cover many aspects of DP diving systems and operations, they are not definitive and decisions about features not covered should still be based on these main principles.

#### **7.2.2 Single Point Failures**

A "catastrophic failure" is defined in these Guidelines as a failure that would, of itself, cause risk to divers. In effect this means that the failure would cause the vessel to move from its intended position. A fundamental principle of all DP diving vessel design and operation is that no single fault should cause a catastrophic failure. This principle immediately introduces the concept of redundancy. In doing so, it must be stressed that redundancy can be achieved in several ways (not merely by duplication).

#### **7.2.3 Capabilities and Limitations of DP Diving Systems**

Any system can operate satisfactorily provided it is not subjected to conditions that are outside its operating capabilities. A fundamental principle of DP diving vessel operation is that the operating requirements of the system are never allowed to exceed the vessel's capabilities in any respect. This principle of itself requires that the vessel's capabilities and limitations are clearly understood and updated with experience and that indications are provided when pre-determined limits are being approached.



### 7.2.4 Personnel Capabilities

Any equipment or system can only work as intended if it is operated correctly. The more complicated the equipment or system, the greater the demands upon personnel operating it. A fundamental principle of DP diving vessel operation is that relevant personnel should be fully capable of performing the tasks entrusted to them. This requires their having the necessary background and experience or being given appropriate training and guidance.

## 7.3 DP SYSTEM

### 7.3.1 Introduction

Implementation of the first principle defined in 7.2.2 above involves correct system design. In the context of these Guidelines, the DP system is defined as “all equipment and components involved in retaining the vessel in its required position.” The principle states that “no single fault should cause a catastrophic failure.” To ensure that a DP system adheres to this principle, a Failure Modes and Effects Analysis of the main components should always be carried out. Where such an analysis indicates that a single fault could lead to a catastrophic failure the relevant component, sub system, or its operating procedures should be redesigned to avoid or take account of the effects of the single point of failure. In this section some design considerations concerning the main components of DP systems are examined. Recommendations concerning condition monitoring are included based on the premise that to react correctly, system operators must be aware of the failure of any main components.

### 7.3.2 Thrust Units

#### 1. Configuration

Thrust unit installations should be designed to minimize potential interference of wash with other thrust units, sensor systems, the diving system and the divers, and the effect of hull surfaces on thrust unit efficiency within the constraint of ship design.

#### 2. Redundancy

Thrust units and, where appropriate, rudders should be situated to achieve fore and aft, athwart ships, and rotational thrust mid so configured that the loss of any one thrust unit always leaves sufficient thrust in each direction to ensure that the vessel holds position and heading when operating within its forecast operational capability.

#### 3. Failure Mode

In the event of pitch, azimuth, motor speed control malfunction or when control error becomes unacceptable the function controlled may remain the same as it was at the time of failure, the pitch be automatically set to zero, or the thrust unit automatically stopped and deselected. Under no circumstances should thrust units assume maximum thrust condition on failure.

#### 4. Emergency Stop

Means should be available whereby any thrust unit may be stopped from any DP control without using the DP computer to generate the command. The means provided should be adequately protected against inadvertent operation.

#### 5. Condition Monitoring

The following list indicates the main functions which, where applicable, should be monitored either by permanent remote means or by local means at frequent intervals. Those marked in boldface should also be suitably alarmed.

- Status (on-line/off-line)
- Thruster motor stator winding temperature (high only)
- Thrust unit r.p.m/pitch ordered and indicated (with display or 80% thrust output)
- Oil pressure
- Hydraulic power-pack status
- Azimuth ordered and indicated
- Thrust bearing temperature
- Power supply loss
- Lube oil/hydraulic fluids—pressure/temperature/level
- Response to command signal deviation

**Note: Monitoring of diesel engines where used to drive thrusters by direct drive should be in accordance with design parameters of the system.**

### 7.3.3 Power System

#### 1. Power Factors

Power system design should, so far as possible, provide for generators to be run at power factors which effectively match the characteristics of the load.

#### 2. Redundancy

The power source system, whether individual diesels or central electricity generation plants, should be capable of producing sufficient power to meet the vessel's operational capability subsequent to the failure of any single power unit.

#### 3. Power Management

Arrangements should be provided to ensure that when diving operations are being carried out non-essential loads are shed in reverse order of importance before power consumption reaches maximum available supply. Power supplies to thrusters to maintain station, as well as to the diving system, should be safeguarded. Arrangements should also be made to ensure that sufficient power is always available to enable the vessel to retain position within a predetermined accuracy in prevailing and foreseeable conditions if any one on-line power unit fails. This may mean providing for running up and bringing on-line additional power units as power consumption increases.

#### 4. Essential Services

Essential services such as fuel, oil, ventilation, and generator cooling should also be designed to avoid system failures stemming from failures of critical components, i.e., filters, pumps, power supplies, etc.

#### 5. Operating Limits

Power operating limits should be specified and alarmed for diesel engines, turbines, motors, and generators to avoid engine damage and power factor problems.

#### 6. Distribution Network

Power distribution systems should be such that no single failure can prevent distribution or sufficient power to thrusters to permit the operation of the vessel within its full operational limitations.

#### 7. Condition Monitoring

The following list indicates the main functions which, if applicable, should be monitored either by permanent remote means or by routine local means at frequent intervals.

- Distribution Network
  - Circuit breaker status (auto connect/disconnect equipment)



- Bus bar voltage
- User current levels
- Load shedding trips (on-line and tripped)
- Back-up power supplies availability (emergency generator or accumulator batteries)
- Diesel Engines
  - RPM
  - Oil pressure/temperature
  - High main bearing temperature indication
  - Auto-start equipment and sequence
  - Bank and individual exhaust temperature
  - Oil level
  - On-line fuel tank level
  - Fuel pressure
  - Fuel rack setting (if applicable)
  - Clutch status (if applicable)
  - Jacket water pressure and temperature
  - Salt water-cooling pressure
  - Change air pressure (where applicable)
- Generator/Motors
  - Bearing lube oil flow and temperature
  - Terminal voltage
  - Current
  - Stator winding temperature (high only)
  - Frequency (low)/speed
  - Status (shut down, stand-by, on-line)

### 7.3.4 DP Information Input Systems

#### 1. Position Sensor Redundancy

It is recommended that at least three independent position sensors be available. These need not all work on different principles but if similar systems are to be considered as independent, they should not be subject to common mode failures (i.e., no single factor should affect more than one system). Whenever DP diving operations are being carried out, at least two independent sensors should be deployed, connected to the DP computer(s), and in use. It is recommended that the third sensor, if not on-line, should be ready for immediate use as a back up. To aid the correct use of sensors in particular circumstances, manufacturers must provide information about the performance and operational limitations of any position reference sensors supplied for use by DP diving support vessels.

#### 2. Vertical Reference Units/Systems

Two VRUs/VRSs should be operating whenever DP diving operations are being carried out and position reference sensors requiring their input are in use. At least one of them should be on-line.

#### 3. Wind Sensors

Care should be taken in siting wind sensors to minimize the effect of turbulence from superstructures. The effect of helicopter downdraft, though normally limited, should be borne in mind. Two wind sensors should be installed in physically separated positions to take account of failures and false readings resulting from external factors. In some circumstances where interference is unavoidable, the inaccuracies caused by switching off wind sensors may be less than those caused by their false information.

#### 4. **Heading Reference Sensors**

Two independent heading reference sensors (i.e., gyrocompass) should be running with either both on-line or one on-line and one available as immediate back up during DP diving operations. Automatic or manual selection of the on-line compass may be provided.

#### 5. **Reliability**

Sensors should be designed and proven for continuous reliability in the exposed positions in which they operate.

#### 6. **Condition Monitoring**

Monitoring of DP information input systems should include:

- Facilities for regular full function checks
- Alarms for transducer or circuitry failures
- Detection of data deviation or corruption
- Alarm for power supply loss

#### 7. **Position Data Processing**

Data from all position sensors should be automatically processed (not manually selected):

- To reject spurious data
- To stabilize output in the event of failure
- To select preferred data
- To alarm if system develops bad geometry or signal loss occurs
- To permit a smooth changeover between systems
- To monitor the sensor status

### 7.3.5 **Computer/Control System**

#### 1. **Purpose**

The primary purpose of the DP control system computer is to calculate and order the necessary thrust unit operations required to maintain a vessel in its chosen position. Though it is possible to use the computer for many ancillary functions (i.e., data processing and presentation, power management, etc.), care should be taken to ensure that these cannot prejudice its proper operation in its primary role.

#### 2. **Control System Redundancy**

There should be at least one back-up method of controlling the vessel's thrust units in order to retain position in the event of a failure of the on-line control system. A second automatic control system can best fulfill this role. If a second automatic system is not fitted, then a joystick control system would be an acceptable back-up provided:

- It affords manual control of fore and aft, athwartships, and rotational thrust with automatic control of heading.
- The joystick control lever is situated in the DP control area and located in such a position that the operator has a clear view of the vessel and everything in its vicinity.
- The joystick control system and its power supply are independent of the failed automatic control unit, but provision is made to ensure smooth continuity of thrust unit operation on failure of the automatic control unit.
- Data from a gyrocompass are input direct to the joystick control system.
- A simple display of vessel position relative to its required position is provided independent of the failed unit, but with the means to ensure its correct alignment with the failed unit at the time of failure.



- It is only used to maintain position for short periods of time, i.e., to recover divers in an emergency. It is recommended that the automatic control system(s) embody a joystick facility to assist in maneuvering the vessel onto location.
3. **Power supplies**  
Provision should be made to ensure that power supplies to computer(s)/controller(s) are safeguarded at all times. This could involve provision of duplicated conversion machinery and a back-up battery supply. Batteries should have sufficient capacity to maintain the necessary supplies for at least 30 minutes and a warning of batteries not being fully charged should be provided.
  4. **Services Redundancy**  
Where possible, the design should ensure that services are duplicated and are so divided that if local ventilation and cooling fail, or fire or flooding occurs, sufficient services are retained to enable the divers to be recovered safely.
  5. **DP Console Sitting**  
The DP console should be so situated that the DP operator can observe DP controls, see outside the vessel, and be aware of deck operations and the vessel's relationship to surface structures, etc.
  6. **Monitoring Information**  
Overall monitoring information should be displayed or made available for call-up in a manner which avoids information overload on the DP operator. Data should be displayed in the simplest manner for easy assimilation. The following information should be available to assist in monitoring overall DP performance:
    - Thrust unit configuration and r.p.m. or pitch levels ordered and indicated (with display of 80% thrust)
    - Consumed on-line power as percentage of total of available (with special indications at 80%)
    - Available thrust units on stand-by
    - Position sensor status and validity
    - DP System status and validity
    - Vessel's target and indicated position
    - Vessel's target and indicated heading
    - Alert level status (manually operated)
    - Limited history event recording system

This should provide an automatic record of changes in the main parameters concerned with the vessel's performance such as:

    - Wind speed and direction
    - Position and heading errors
    - Position reference sensor availability and use
    - Thrust unit availability and use
    - Power unit availability and use
    - Computer availability and use

### 7.3.6 Communication Systems

#### 1. Internal Voice Communications

As a minimum requirement, voice communications should be available to ensure the immediate and clear transfer of information between all responsible parties.

As a minimum requirement, direct communications should be provided between DP console and dive control; dive control - bell and diver; dive control and life support control; dive control and bell handling control; dive control, DP console, and ship's



derrick or crane; DP console and Master's cabin; dive control, DP console, and senior Diving Supervisor's cabin; and DP console and engine (control) room.

All essential voice communications systems should be provided with 100% redundancy where practicable either through duplication or provision of an alternative system. Terminals should be situated close to the normal operating positions of personnel for whom they are provided. Primary systems should provide clear voice reproduction and should not detract from users ability to perform their main function.

## **2. DP Alert System**

A system of lights shall be provided in the saturation control room, air or mixed-gas diving control area, working deck, and, where applicable, the ROV or submersible control position manually activated from and repeated in the DP control room. The lights should be:

- Steady green light to indicate vessel under automatic DP control, normal operational status and confirming the Alert System is functional.
- Flashing yellow light to indicate degraded DP operating alert.
- Flashing red light to indicate DP emergency.

A distinctive alarm should sound in the saturation control room, air or mixed-gas diving area, the Master's cabin, Operations Superintendent's cabin (if applicable), and Senior Diving Supervisor's cabin in conjunction with the flashing red light. Provision of a means of cancelling the audio and flashing functions of the signals from the receiving positions when they have been noted should be made.

### **7.3.7 Maintenance of Equipment**

Proper maintenance of equipment is essential to its correct performance. Clear instructions about the type and frequency of maintenance required by all components of DP systems should be compiled by vessel owners with the aid of manufacturers and suppliers. These should be issued to vessels together with a system to monitor their correct implementation.

## **7.4 CAPABILITIES AND LIMITATIONS**

### **7.4.1 Introduction**

The second principle, defined in 10.2.3 involves knowledge of a vessel's capabilities and the operating requirements. An awareness of the special limitations of diving from a DP vessel should be present at all times amongst those concerned with the operation. In addition, certain principles should be adopted to minimize the possibility and effects of the risks to divers due to uncontrolled vessel movements. Notwithstanding these principles, the authority of appropriate personnel to order the termination of DP diving operations if they consider them hazardous even when conditions are within the Guideline limits should not be diminished.

### **7.4.2 Vessel's Operational Capability**

The maximum continuous operational station-keeping capabilities for DP diving should be forecast for each DP diving support vessel. These should be expressed in terms of direction and magnitude of wind, associated wave drift force, and current combinations. They should be defined as "those environmental conditions in which the vessel could maintain chosen position and heading to a satisfactory confidence level with any single thrust or power unit failed and with power available for the foreseeable diving requirements and the vessel's essential services." Capability plots or envelopes of these maximum tolerable environmental forces and their relative heading should be produced to assist in defining this information. These should



include a statement of the position and heading tolerances and the corresponding confidence levels associated with the capability plots. It should be clearly appreciated that they are only a guide to a vessel's position keeping capabilities and an indication of those capabilities under certain conditions.

Capability plots should be based initially on vessel design information, but should be modified in the light of practical experience. Care should be taken that such modifications are properly reviewed and authorized by the vessel owner. Detailed explanations of the assumptions made in producing these plots should be provided. For example, the power consumption of the diving system and emergency domestic load, the definition of wind speed and thrust output, the assumed wave drift and current conditions, and details of the means to identify the position keeping tolerance and corresponding confidence levels should be included.

It should be noted that the requirement to hold station and heading within operational limits with any single thrust or power unit failed assumes a "worst case" failure. Therefore, in determining the operational limit "envelope," the chosen "worst case" thrust unit will probably vary depending on the relative direction of environmental forces. This should be taken into account.

When determining the vessel's position holding capability, consideration should also be given to any interactions between thrust units, hull, and relative water movement. To simplify the calculation/presentation task, it is proposed that the current force be based on a one-knot current running in the same direction as the chosen wind and wave forces and that the number of "directions" chosen for these coincident forces may be limited to 30° increments.

### **7.4.3 Degraded Operational Capability**

The principle of ensuring that no single fault can cause a catastrophic failure allows the vessel to be operated with confidence within its designed operational limitations. If the operational capability is degraded, the operation of the vessel should reflect the new status. There is one principal source of degradation of operational capability, namely loss of redundancy of a subsystem. Warning of such loss is provided by the condition monitoring arrangements referred to in Section 7.3.

### **7.4.4 Positioning Accuracy**

The positioning accuracy of a DP vessel is subject to several sources of error which can act cumulatively. A forecast of the position and heading tolerances and the corresponding confidence levels should be included with capability plots and should be taken into account when planning operations close to other vessel installations. Excursions around the intended position, even if causing no worse problems, tend to swing the bell in a manner which, if it becomes excessive, may be dangerous. With surface supplied air or mixed-gas diving operations, excessive excursions of the vessel could cause hazard to the diver. Their reduction to the minimum achievable level should be a matter of priority both on setting up on DP and, if necessary, in the course of DP operations.

### **7.4.5 Operating Procedures**

The objective of all operations should be to ensure that a vessel operates effectively and safely. To achieve this, using the design principles already stated, carefully prepared operating procedures should be adopted. These should themselves be based on three main principles:

- Systems are checked on installation and after relevant modification, before starting new charters, and immediately before and periodically during use.
- Operational capability is matched by operational status.
- The procedures adopted should take account of the limitations of the system.

These principles lead to several outline operating procedures which are explained below.

#### **1. DP Proving Trials**

All the precautions and procedures described herein will be to no avail if the DP system includes uncorrected faults remaining after its original construction. Before a DP diving



vessel undertakes DP diving operations after construction or any relevant modification, it should undergo a full series of trials.

These should include testing and tuning in harbor, followed by sea trials, during which the vessel's position keeping system should be thoroughly tested under normal and breakdown conditions, and should culminate in a DP bell dive. It is stressed that commissioning of systems, piece by piece, cannot replace the need for thorough testing of the total system under working conditions. It is likely that such trials, if properly conducted, would take several days. Where possible, they should be performed partly in a situation where accurate monitoring of the vessel's position can be achieved and partly in open water under realistic environmental conditions. The results of these trials should be used to confirm or refine the vessel's performance capability statements.

As an indication of appropriate DP proving trials, checks of the following could be made:

- **In Harbor**
  - Correct siting and mounting of all equipment and cabling
  - Correct wiring of all power supplies, data cabling, and equipment
  - Correct functioning of all equipment (including data input systems, computers, interfacing equipment, thruster units, and power supplies) by electronic and functional testing
  - Effective shielding of all potential sources of electrical interference (including those which may only be used intermittently)
  - Software checks and tuning
  - Correct functioning of all condition monitoring systems and alarms
- **At Sea**
  - Correct functioning of all data input system
  - Correct functioning of computers and interfacing
  - Correct functioning of power management systems
  - Correct functioning of thrust units including response times
  - Optimum position-keeping performance by fine-tuning of software
  - Insure position-keeping accuracy using independent means
  - Correct functioning of all automatic and manual change-over arrangements and procedures from primary to back-up systems
  - Correct functioning of offset and heading change control
  - Satisfactory operation of DP system with bell running and then divers in water
  - Position keeping per ordinance in rough weather

It is stressed that this list is not definitive, but is included as an indication of the type of testing required.

## 2. **New Charter Assessments**

In fulfilling their responsibilities under national regulations, diving contractors and field operators whose operations involve the use of DP diving vessels should, before they permit DP diving operations to be carried out, satisfy themselves about the vessel's suitability for the operations planned. This could involve a thorough assessment of a vessel's DP arrangements in line with these Guidelines including a study of relevant documentation such as Operations Manual, FMEA Report, Capability Plot, and any other form of DP system assessment available together with summaries of the



experience of personnel involved with DP operations based on their Operators Logs. It should also include a short sea trial during which the actual capability of the vessel and crew to support DP diving in both primary and breakdown conditions should be assessed. Such trials could, if the vessel is satisfactory, be completed in some 8 to 10 hours.

### 3. **Operating Checks**

A program of functional checks designed to test the operation of a DP system including the selection and operation of back-up systems should be performed whenever setting up on DP. For example, these could include but not be limited to, simulation of failures of on-line components such as a DP computer, a position reference sensor, a gyro, a generator, or a thrust unit. They could also include commanding offsets in both direction and heading. In addition to the successful completion of these checks, the vessel should have held station automatically within the defined degree of accuracy until the Master and Senior Diving Supervisor are confident that the system is reliably set-up before diving operations are permitted to start. This may take at least 30 minutes.

Re-positioning of a vessel under DP control would not require a repeat of this check period. It is recommended that some or all of these checks be repeated periodically while on DP, but when diving is not being carried out and position keeping is not crucial. By doing so the continued correct functioning of the system can be checked while the readiness of operators to deal with emergencies is enhanced. Instructions for the performance of these checks should be prepared and written by the vessel owner with the assistance of the DP system manufacturer and could be produced in the form of a checklist in a card or folder for ease of use. A more comprehensive arrangement could be provided by a purpose-built simulator.

### 4. **DP Alerts**

When diving on DP, a clear system to indicate and guide responses to operational capability is important. This system should be based on a minimal number of standard operating status levels representing the capability of the DP system to retain the vessel on station within safe limits. It is recommended that these levels should represent the following conditions:

- **Normal Operational Status (Green Light)**

The vessel can be defined as in “normal operational status” when all the following conditions apply:

- The vessel is under DP control and the DP system is operating normally with appropriate back-up systems available.
- Thruster outputs and total power consumption (where applicable) do not exceed 80% of maximum thrust and total available power respectively for more than brief and isolated periods.
- Vessel’s indicated position and heading is within predetermined limits for all but brief and isolated periods. These limits should be determined for each location.
- No risk of collision exists.

- **Degraded Operational Status (Yellow Alert)**

The vessel can be defined as being in degraded operational status when any of the following conditions applies:

- There is a failure in a sub-system leaving the DP system in an operational state (possibly after reconfiguration) but with no suitable back-up available so that an additional fault occurrence could result in DP system breakdown and assumption of Emergency Status.

- Available power units are reduced to the extent that failure of one more could prevent the vessel holding position or heading in existing or foreseeable conditions.
  - Available thrust units are reduced to the extent that failure of one more could prevent the vessel holding position or heading in existing and foreseeable conditions.
  - With all available thrust and power units on-line, any thrust unit output exceeds 80% of its maximum thrust or total power consumption exceeds 80% of total available power for more than brief and isolated periods.
  - Vessel's indicated position deviates beyond predetermined limits for more than brief and isolated periods.
  - Risk of collision exists.
  - Weather conditions are judged to be becoming unsuitable for DP diving.
- **Emergency Status (Red Alert)**  
A vessel can be defined as in Emergency Status if either of the following Conditions applies:
    - System failure results in inability to maintain positioning or heading control.
    - Any external condition exists, including imminent collision, which prevents the vessel from maintaining position.

## 5. Alert Level Responses

The following responses could be made to different alert levels. Visual and audible signals should be manually initiated by the DP Operator.

- **Normal Operational Status (Green Light)**  
Full DP diving operations can be undertaken.
- **Degraded Operational Status (Yellow Alert)**  
The Master and Senior Diving Supervisor should be informed. The Diving Supervisor should be informed. The Diving Supervisor should order the diver(s) to return immediately to the bell and obtain a seal. A decision should be taken by the senior Diving Supervisor, in conjunction with the master, in the light of prevailing conditions and any possible mitigating actions available whether to abort the dive or not or, where surface supplied diving is being conducted, prepare to return to the surface. Under this condition, air or mixed-gas divers should be ordered to return to the surface.
- **Emergency Status (Red Alert)**  
The diver(s) should be ordered immediately to return to the bell and obtain a seal. The Diving Supervisor should order the bell to be recovered as soon as possible after consideration of hazards involved in doing so (i.e., fouling of anchor wires, jacket members, etc.) or, where surface supplied diving is being conducted, prepare to return to the surface. The DP operator should use all means available to maintain the vessel in position until the divers are sealed in the bell and the bell is clear of obstructions. The Diving Supervisor and Master should be verbally informed as soon as possible. Under this condition air or mixed-gas divers should be ordered to return to the surface.

## 6. Communications

Communications between the dive control position and the DP console should be regular and frequent. Each watchkeeper should inform the other about any change in operational circumstances that occurs or that is planned.



The following list gives an indication of the type of information which should be passed:

- Dive Control to DP Operator
  - Bell status
  - Diver status
  - Intention to use water jetting or other underwater equipment
  - Possibility of divers, bell equipment, etc. blanking or moving acoustic reference signals
  - Any situation which could develop into an emergency
- DP Operations to Dive Control
  - Intention to move vessel
  - Any change in operational status
  - Background information on causes of changes in operational status
  - Any forecast or actual significant changes in weather
  - Ship and helicopter movements in the vicinity
  - Intention to handle down-lines of any description including repositioning taut wire weight.
  - Intent to bring small boats alongside
  - Intent to place anything into the water

The following list indicates the type of information needed by the DP Operator about activities in the vessel:

- Intention to perform and notification of completion of any electrical or mechanical system maintenance or modification which could directly affect on-line DP equipment or make stand-by equipment unavailable
- Intention to start and stop ancillary air/hydraulic units which may reduce pressure on DP or diving associated equipment
- Intention to start and stop pumping of bilges, discharge of sewage, galley waste, etc.
- Intention to start and stop the use of radio and radar equipment which may affect the DP system
- Intention to handle equipment which may affect the trim of the vessel
- Imminent arrival or departure of helicopter or vessel alongside

The following list indicates the type of information which should be passed between the DP Operator and the platform:

- Platform to DP Operator
  - Planned movements of vessels and helicopters
  - Planned crane lifts or outside platform work which could interfere with the diving operation, or beacon, or transponder sites
  - Intention to discharge mud, galley waste, etc.
  - Planned blackouts in communications or power and hazardous operations (i.e., well-tests)
  - Weather information
  - Other subset operations
- Taut Wire Systems
  - Regular inspection and maintenance of the wire should be carried out. It should also be cut back and re-secured to the weight frequently to ensure that wear does not become excessive at either the weight or the sheave.
  - Care should be taken in the choice of its position in the vessel to minimize the mechanical limitations of the system. This is particularly important in higher sea states due to the movement of the vessel. It should also be situated as far as practicable from the moon-pool or other diving position.

- Care should be taken to ensure that the taut wire does not lift off the bottom or, if it does, that an indication of it having done so is given automatically to the DP operator.
  - Measures should be taken to prevent danger to divers if the taut wire is moved and to avoid interference with the taut wire by divers.
  - The taut wire should be lowered to a position as far as possible from subsea pipelines, flowlines, or cables any of which may move.
  - The mechanical limitations to the angle at which the taut wire can effectively operate introduce a limit to the distance from the intended position to which a vessel may deviate. This is of particular importance in shallow water.
- **Short Range Radio Systems**
    - Vessel operators should be aware of the possibility of temporary loss of information. i.e., due to blanking by other vessels, helicopters, platform equipment, or occasionally rain squalls and action should be taken to avoid or minimize the effects of this.
    - Remote beacons or transponders mounted on manned production platforms are vulnerable to manual interference. Steps should be taken to ensure that they are not tampered with or “blanked off” and that their power supplies are not interrupted. This could include providing battery back-up, connection to the platform’s essential service supplies, and siting them in accessible positions. A warning signal should indicate that the main power supply has been cut and the system is working on batteries. The owner of the platform should be responsible for the security of equipment located on the platform.
    - Where possible, alternative frequencies or codes should be prepared to cover the possibility of interference but should be allocated with care.
    - The vessel’s position and resulting reference station geometry should be carefully considered whenever a move is contemplated.
    - Interference from radar can cause temporary signal failure or error.

## 7. **Down-Line Handling and Interference with DP Sensors**

The handling of all down-lines from DP ships requires special care in the following respects:

- **Taut Wire Errors**

Long horizontally slung objects which can pivot when suspended in the water can and have come into contact with taut wires which are providing positioning information. Care should be exercised to avoid this.

- **Snagging of Divers**

Any down-line can snag a diver. Down-lines should only be handled by people experienced in doing so and under supervision of the Diving Supervisor, if necessary, via the bridge. This is particularly relevant when the vessel is being moved.

- **Moving Acoustic Beacons or Transponders**

Acoustic devices should only be moved by divers under the supervision of the Diving Supervisor and on the direct authority of the Master who should be continuously advised of their movement.

- **Down-lines**

Down-lines should be made up to include a breaking section to reduce the chances of injury to divers.

## 8. **Uncontrolled Movement**

The conduct of diving operations from DP vessels, as opposed to other types, requires particular attention to the risk to divers due to vessel movement. The effect of the vessel moving off station can cause failure of main lift wires, life-support and/or communication arrangements between the vessel and bell, vessel and diver(s), or bell



and diver(s). Operating and emergency procedures should be established to minimize the risks and adequate arrangements should be made for the provision of emergency life support, communications, and relocation devices to allow a successful recovery. The bell or divers should always be positioned with care and, whenever possible, above the level of potential instructions. The possibility of releasing the tension on the winch wire umbilical and clump weight wire the bell is on the bottom to avoid dragging it if position is lost, should be considered. Generally, divers should not enter confined spaces when diving from DP vessels. However, in special circumstances and with due regard to the provision of particular means to ensure their safety in case of DP failure, such operations may be permitted.

#### **9. Operations Plot and Emergency Plans**

A plot displaying the relative positions of the vessel, the bell, divers, the worksite, and any known obstruction (i.e., platform, other vessels, mooring wires, wellheads, etc.) together with ship's heading and wind direction and speed should be maintained at all times at the DP control position. The DP watch keepers should ensure that this plot is always kept up-to-date and that planned emergency procedures have been approved by the Diving Supervisor to provide for the action to be taken in case of DP or other emergency. These plans should be produced in advance of any diving operations, be reviewed, and modified as appropriate.

#### **10. Vessel Movement Limitations**

When the bell is launched or divers are deployed, DP diving vessels should only be moved with the full knowledge and consent of those concerned (in particular the divers) under very restricted and controlled circumstances, as follows:

- Under automatic DP Control
- Generally the vessel should not be moved while divers are in the water. However in special circumstances and with due regard to hazardous obstructions, the Master, with the agreement of the Diving Supervisor, should be able to authorize limited vessel movements with the divers in the water directed by the Diving Supervisor. Such movements should not exceed the limitations of the reference sensors and should be made at slow speed. Heading changes should not exceed 15%. When moving, bell divers should be in the close vicinity of the bell (i.e., on the clump weight).
- Limited movements of the vessel which are greater than those described above should only be where divers have been recovered to the vessel and with bell divers inside the bell recovered to the vessel or positively clear of any potential hazardous obstructions, including the seabed.
- When moving the vessel on DP, particular consideration should be given to:
  - Where the bell is cross-hauled or the vessel's vertical axis of rotation does not coincide with the moonpool, in addition to the limitations established above, heading changes should not exceed an angle which causes a 10 meter movement of the bell.
  - The possible snagging of down-lines with the bell winch wire and umbilical should never be in a bight when moving as it is liable to snag obstructions.

#### **11. DP Operations In Vicinity of Platforms, Etc.**

Particular care must be exercised when operating on DP in close proximity to fixed objects such as production platforms, mooring buoys, etc. When DP diving is undertaken in the vicinity of anchor wires and cables, the inaccuracy in the knowledge of their actual position at any particular time and the resulting need to keep the bell and bell wires as far from them as possible should be taken into account.



## 12. Visual Reference Points

When close to fixed structures, their value as a visual reference to provide an early additional indication of DP failure should be considered.

## 13. DP Operations In Vicinity of other DP Vessels

When operating on DP close to one another, DP vessels are potentially subject to several forms of mutual interference. These include thruster wash, which may affect both hulls and taut wires, acoustic and radio position reference sensor signals, and intermittent shelter from wind and sea. These factors should be considered when planning such operations and due allowance made for them. This may take the form of assuming less accurate position keeping tolerance than would nominally be expected, but could also include co-ordination of choice of position reference sensors and frequencies and careful choice of the relative positions of the vessels.

## 14. DP Operations In Shallow Water

During shallow water operations, there are indications that the limitations of acoustic and taut-wire reference sensors, in terms of the distance from the intended position at which these sensors can operate correctly can introduce an extra hazard above those normally associated with their use in deep water. The need to use a surface reference sensor as one of the sensors in such operations is therefore of particular importance. The effect of the strong tidal streams and currents sometimes associated with shallow water should also be taken into account in relation to the position keeping capabilities of DP vessels.

## 15. Surface Orientated Diving

The following requirements for surface diving operations are only in effect when the vessel is operating in the DP mode. "DP Mode" is defined as whenever there is any form of motive power in operation, i.e., thrusters or propellers. The requirements are based on the premise that at no time should the length of umbilical from the tending point to the diver allow the diver to come into contact with the nearest thruster or propeller that is in an operating mode. Very great care is needed in the planning and execution of shallow and surface orientated diving operations to minimize the effect of thrust units on the divers. The effects of thrust unit wash or suction should be carefully considered and precautions taken to guard against them particularly when the bell or divers pass the potential wash zone. These precautions could include appropriate computer software to avoid any hazardous effects on the operation of the bell or divers. The use of thrust diagrams when planning dives can also help. Inhibiting or deselecting certain thrusters may be necessary and the resulting reduction in the vessel's operational limitations should be taken into account. Divers umbilical lengths and the manner of deploying them (i.e., over the side, from the bell, etc.) should be so chosen that divers and their umbilical are physically restrained from going to positions where they or their equipment could come into contact with thrust units or be adversely affected by their wash. Furthermore, care should always be taken to prevent umbilical developing a bight, and to respond at once to any indications of a diver being in difficulty such as unusual tension on or at the angle of the umbilical. There is no simple approach to the problem due to the differences encountered in the vessels and worksites.

Surface diving can be performed from a DP vessel in the DP mode whether over the side or through the moonpool, if the following conditions are met:

- All of the U.S.C.G. requirements and limits of 46 CFR 197.432 Surface Supplied Air Diving and 46 CFR 197.434 Surface Supplied Mixed Gas Diving must be complied with.



- Written procedures, as must regulations in effect in other nations, must be prepared for emergency situations (i.e., changes in alert level status, alarms, loss of communications, moving the vessel, etc.).
- The diving crew must be familiar with the vessels overall design and operating characteristics (i.e., position of thrusters, propellers, intakes, obstructions, etc.)
- The dive must be conducted from a Class II bell (Wet Bell).
- Consideration should be given to tending the diver from the wet bell especially in the case of significant obstructions on the seabed or for structural penetrations.
- The diver and standby diver tending must be in direct communications with the Dive Supervisor at all times.
- The Diver Supervisor must be provided with relevant DP alarms and communications systems to the bridge and/or DP control station.
- The topside tenders must be able to listen to all communications between the divers and the Supervisor and must be able to talk directly to the Supervisor.
- The belt umbilical and/or divers umbilical supplying the wet bell and/or divers with appropriate services must be secured to the main lift wire.
- The excursion umbilical are secured to the wet bell so that the length of the umbilical from the tending point to the diver work site shall never be greater than the distance from the tending point to the nearest thruster. The umbilical must be appropriately marked.

#### 16. Weather Precautions

Due regard should be paid to any indications of impending weather changes, in particular sudden wind shifts and/or gusts. In winter, sudden changes in direction and increases in strength of wind often occur. The use of onboard meteorological instruments including barometer, barograph, wind sensors (both fixed and portable), and wet and dry thermometer is necessary to ensure that timely action is being taken to reduce the possibility of loss of position. In conditions where wind and waves are from opposite sides of the fore and aft line of a vessel, particular care is required as a wind shift to coincide with wave direction is likely to cause rapid change in resultant force on the vessel. A warning of instability when the weather is from roughly ahead or astern to be obtained from thrust unit movements alternating frequently through 180° using appreciable thrust (say over 40%) A case has occurred of a complete power failure resulting from a DP ship being struck by lightning. All reasonable precautions in accordance with good marine practice should be taken to ensure that forecasts of changing weather conditions are obtained and acted upon. These precautions should include:

- Obtaining regular and frequent weather forecasts for the area of operations and use of facsimile facilities and charts
- Seeking information by radio from other units in the vicinity about prevailing weather conditions in their areas
- Use of experience and a “seaman’s eye” in assessing the prevailing conditions and likely trends
- The presentation of environmental information measured by the DP system and any trends in conditions which it can provide.

#### 17. Collision Risk

Care should be exercised at all times to ensure that the correct lights and shapes are displayed in accordance with the latest international collision regulations (see Appendix C). By the present rules whereas power driven and sailing vessels are required to keep out of the way of a vessel restricted in its ability to maneuver (i.e., a DP diving vessel), a vessel engaged in fishing when underway is required only “so far as possible” to do so.



The Master of a DP diving vessel should give early warning that it is unable to maneuver to any vessel which appears to be on a collision course using visual and sound signals. The potential use, if properly employed, of a simple automatic collision warning system should not be overlooked. In conditions of reduced visibility, decisions about the suitability of conditions for diving should rest with the Master of the vessel.

## 7.5 PERSONNEL CAPABILITIES

The third principle, defined in 7.2.4, concerns the ability of the personnel onboard to perform the tasks entrusted to them. There should be sufficient personnel having suitable training and experience to ensure the safety of the vessel and all those on board.

### 7.5.1 Authorities

Nothing in these Guidelines shall supercede the spirit or letter of legislation covering the authorities of Masters of Merchant Vessels, of supervisory staff responsible for diving, project control, and offshore installations. It is however of fundamental importance that the authorities of all personnel concerned with the management of diving operations conducted from dynamically positioned vessels be thoroughly and clearly defined. The responsibility of defining detailed authorities rests with the main contractor who should interpret without losing the spirit of the main principles. However the sections below give general guidelines.

#### 1. The Master

The Master of the vessel is ultimately responsible for the safety of his vessel and all personnel on board working from her, and has ultimate authority to forbid the start or order the termination of diving and DP operations on grounds of safety to personnel or the vessel.

#### 2. Operations Superintendent

The Operations Superintendent, where present, is responsible for the conduct of all operations carried out from the vessel. As such he has authority to forbid the start or order the termination of diving and DP operations for safety or other reasons. He may not order the start of diving or DP operations.

#### 3. The Diving Supervisor

The Diving Supervisor is a diving supervisor appointed by the employer of the divers to be in overall charge of all diving operations from the vessel and is responsible for all aspects of diving safety. He has ultimate authority to permit or forbid the start and to order the termination of any diving operations on grounds of diving safety. Other diving supervisors may, as necessary, be appointed by the diving contractor, but should be under the control of the Diving Supervisor. For the purposes of these Guidelines, it is assumed that any additional diving supervisors have been vested with the authority and operational responsibility of the Diving Supervisor when on duty and until relieved.

#### 4. The Client's Representative

The client's Onboard Representative should, in conjunction with the contractor's Senior Onboard Representative, be responsible to the client for the proper performance or all work in accordance with the contract. He may request the start of DP or diving operations, and should have the authority to veto the start, or order the termination of diving or DP operations on any grounds.



## 5. **Project Liaison**

In view of the additional safety factors involved in DP operations, it is essential that close liaison be maintained between the various authorities concerned. Some organizations may include additional supervisory roles, but the above four authorities should represent the minimum forum for planning meetings concerning DP supported diving operations.

## 6. **Priorities**

Priorities should be clearly established for dealing with a DP emergency. The authorities of the Master and Diving Supervisor are of fundamental importance at such times. They should cooperate closely to these priorities so that there is no room for doubt or dissension. Priorities should take into account that:

- The safety of life is the first priority: The Master has ultimate authority to assess and decide on courses of action in this respect. The advice of the Supervisor should be taken into account.

The safety of property is of lower priority. No effort should be made to safeguard property at the expense of safety to life, but the potential danger to life which some threats to property pose should not be overlooked. The advice of Client's Representative and Offshore Installation Owner should be heeded where possible in respect of the safety of offshore installations and equipment.

## 7. **Manning for DP Diving Operations**

The requirements for numbers of qualified DP operators will vary. However every DP vessel engaged in diving operations should meet the following requirements:

- The Master of a DP diving support vessel, when performing DP diving operations, should be appropriately trained to be responsible for operating the DP system without supervision (see 7.5.3).
- Two watchkeepers should be present in the DP control room whenever DP diving operations are being carried out. One of them should hold an appropriate deck-officer's qualification to be in charge of the navigational watch. One should be responsible for operating the DP system without supervision (see 7.5.3).  
The other should have received suitable instruction on the principles and operation of DP systems (Appendix B). The second watchkeeper may leave the DP control room to attend to ship's business.
- An appropriately trained technician (Appendix B) capable of minor fault finding and maintenance of the DP system should be onboard at all times when DP operations are taking place.
- The period of time for which the watchkeeper referred to above continuously operates the DP system should be limited to avoid loss of concentration. It is unlikely that continuous periods of longer than two hours would be satisfactory and in some circumstances this may need to be shortened.
- Engine rooms (or engine control rooms) should be manned at all times when on DP.

### 7.5.2 **Training and Experience**

The amount of training and experience needed by personnel to perform their functions safely varies. However the following minimum standards are recommended, but some may need to be exceeded in some cases:

- No person should be responsible for operating the DP system in a DP diving vessel without supervision while diving operations are in progress, until he has:
  - Received suitable instructions on the principles and operation of DP systems (Appendix B)

- Attained satisfactory practical experience by completing a suitable period of supervised DP watchkeeping offshore during which he has simulated the main sub-system failures including failure of automatic computer control. It is suggested that a suitable period would be at least 200 hours.
- Satisfactorily completed approximately 50 hours supervised DP watchkeeping on the vessel concerned during which he has simulated the main sub-system failures. To assist the owners to monitor this training, it is recommended that all DP operators maintain a personal log of their DP experience.
- The Technician(s) responsible for minor fault finding and maintenance of the DP control system should have satisfactorily completed a suitable training course (Appendix B).

### 7.5.3 Operations Manual and Records

Clear guidance about the operation of each individual DP diving vessel should be contained in an Operations Manual prepared specifically for that vessel. The manual should contain sections on at least the subjects outlined in the following subparagraphs.

#### 1. Vessels Operational Limitations and Alert Procedure

The limitations and procedures as defined in Section 4 above should be clearly stated.

#### 2. Manning

This section should detail the minimum manning arrangements for the vessel when operating on DP and during diving operations.

#### 3. Responsibilities, Authorities, and Duties

The duties, responsibilities, and authorities of senior personnel should be described based on the guidance in Section 7.5.1.

#### 4. DP Operations

A description of the DP system fitted and guidance on the performance of all DP operations including procedures for:

- Operating checks
- Operations of position reference sensors
- Duration of DP operating periods
- Operations in the vicinity of platforms, etc.
- Standard alert levels (with description of warning signals)
- Precautions with regard to weather
- Measures to prevent collision

#### 5. Diving Operations

An up-to-date description of the diving system(s) and guidance on the conduct of diving operations as they may be affected by the DP vessel itself including procedures for:

- Actions to be taken in case of changes in alert level status
- Operation of divers in free flooding and enclosed spaces
- Precautions to guard against thrust unit wash or suction effect
- Surface support and down-line handling
- Information to be provided to dive control positions
- Preparation and use of emergency plans
- Moving vessel

#### 6. Priorities

Guidance should be given on the priorities to be adopted in case of emergency. These should follow the guidance given in 7.5.1 (#6).



## **7. Communications**

Guidance and procedures concerning the transfer of information based on the guidance in 7.4.5 (#6). modified to suit the particular vessel. This section should also contain a description of the voice communication systems and alarm systems which are available and should define emergency situations.

## **8. Records and Report**

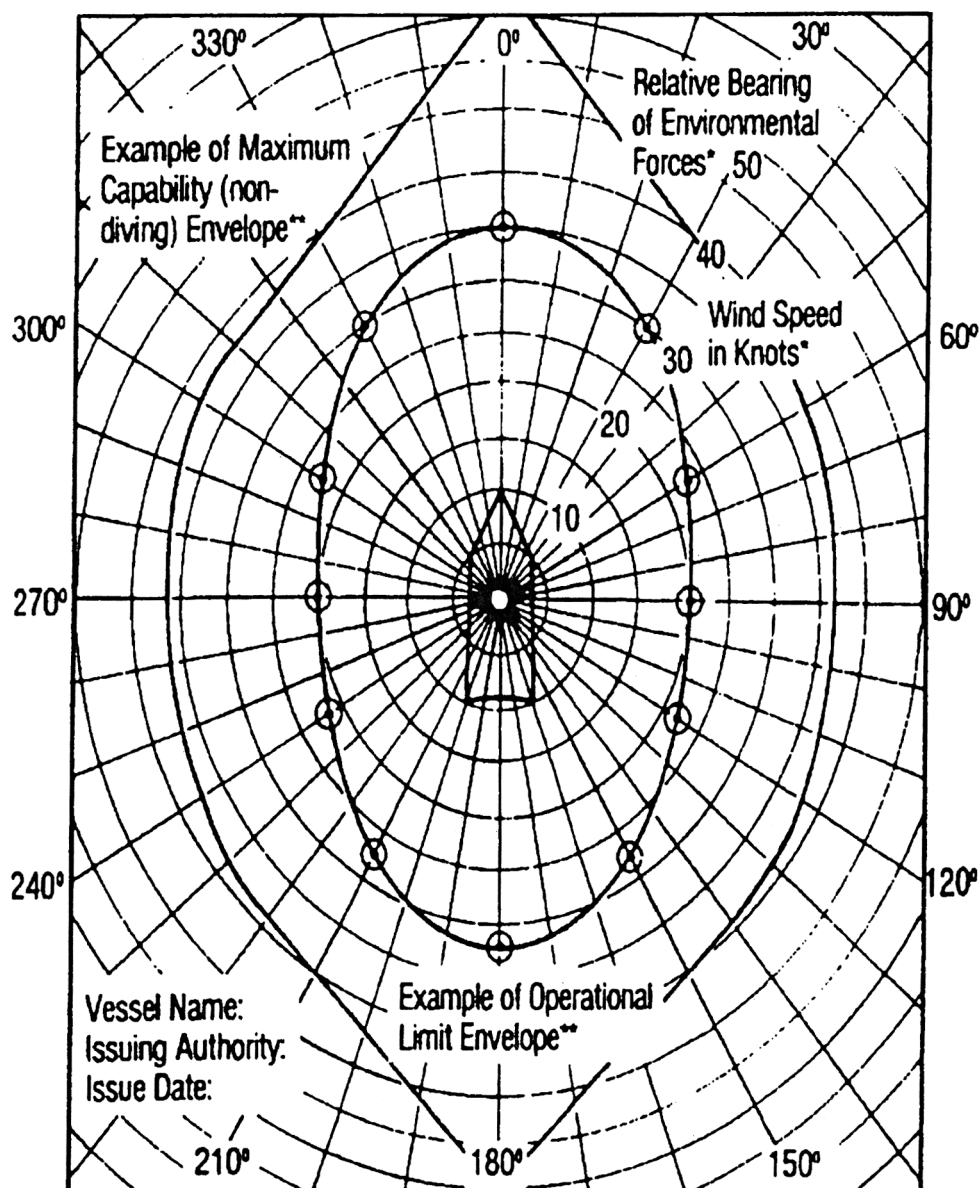
Details of all records and reports required by the Master, Senior Diving Supervisor, and others.

### **7.5.4 Information Feedback**

Lessons learned in the course of practical DP operations can be of use to others besides those immediately involved. Arrangements for the dissemination of information should be established, so that relevant practical experience and the lessons learned can be made available to others to improve the safety of DP diving operations. This may include dissemination within the vessel, the Company, to designers, manufacturers, and shipyards.

## APPENDIX 7.A DP DIVING OPERATIONAL CAPABILITY GRAPH

- Total Environmental Force acting on the vessel is based on wind speeds shown with coincident wind-associated wave and knot current forces.
- The capability envelope represents the wind speed and direction (with coincident wave and current forces) within which the vessel can safely hold position.





## APPENDIX 7.B SUGGESTED INSTRUCTIONS ON THE PRINCIPLES AND OPERATION OF DP SYSTEMS

Paragraphs V-B-2 and V-C of the Guidelines refer to “suitable instruction on the principles and operation of DP systems. The “suitable instruction” referred to is envisaged as being based on the following to “block diagram” level of detail:

- **The Principles of DP Operations**  
The inter-relationship of positioning information, thrust-vectors and vessel movement. Descriptions of the main components of DP systems.
- **DP Information Input Systems**  
Description of the purposes of all DP information input systems and the principles on which they work. Their strengths and weaknesses. Factors to be considered in their operation.
- **Computer/Control Systems**  
The purpose of computer control systems. Brief description of the principle on which they work. Discussion of the manner in which they respond to position error, heading error, wind forces, and how they are designed to control thrust output to take account of the effect of environmental forces on the vessel. Methods used by computers to check the validity of data fed to them, the validity of their own calculations, and the extent to which their command signals are followed. Input of instructions and presentation of information by computer. Computer outputs and interfacing requirements.
- **Thrust Units**  
Types of thrust unit available with comments on their strengths and weaknesses. Power requirements, control systems. Provision of services - including redundancy needs. The potential effect of thrust units on diving operations. Comparison of pitch/r.p.m. and thrust output. Condition monitoring.
- **Power Supplies**  
Direct drive, diesel electric, dedicated ring-main, and ship's ring-main. Power distribution, provision of power to essential services, UPS-principles, and general description. Principles of power management. Provision of services to prime movers. Condition monitoring.
- **Principles of Redundancy**  
Common mode failures, single points of failure, catastrophic failure, failure modes, and effect analyses. Ways to achieve redundancy, duplication of components, provision of alternative back-up systems, and procedural methods.
- **Operational Capabilities**  
Principles of operational capabilities - relationship between thrust output and effect of environmental forces on vessel. Methods of depicting operational capabilities in graphic and plot form. Principle of operational capabilities reflecting failures of thrust or power units. Recognizing approach to maximum operational capabilities in practical operations.
- **DP Operation Simulation**  
The operation of a DP computer controller in simulated conditions. Setting up on DP. Simulated changes in environmental force. Off-setting position and heading. Simulated failures of ‘information input systems, power supplies, thrusters and control Systems.

It is envisaged that such instruction is likely to occupy about five working days. In addition to providing initial training for DP Operators, it could also be of value to owners and charterers personnel.

The instruction outlined above could form the first pan of the training for technicians referred to in paragraph 7.5.2. It should be followed by a suitable maintenance course to provide detail of hardware and software facilities available for diagnosis and repair of the relevant DP system. This would also include practical work on the equipment. This extension to the Operators course could occupy a further five to ten working days depending on the complexity of the system concerned and the background of the technician(s).

## **APPENDIX 7.C DISPLAY OF DIVING LIGHTS, SHAPES, AND FLAGS**

1. Attention is drawn to the International Regulations for Preventing Collisions at Sea - particularly Rules 3(a), 27(b), 27(d), 27(e), 27(g) and 30. Vessels are defined to include every description of water craft including non-displacement craft and sea planes used or capable of being used as a means of transportation on water.
2. The Regulations require that all vessels engaged in dredging or underwater operations, when restricted in ability to maneuver, should exhibit lights and shapes as follows:
  - Three all round lights in a vertical line where they can best be seen. The highest and lowest of these lights should be red and the middle light should be white.
  - Three shapes in a vertical line where they can best be seen. The highest and lowest of these shapes should be balls and the middle one diamond. The shapes should be colored black.
3. If a vessel is engaged in dredging or underwater operations and is making way through the water, then masthead lights, sidelights, and a stern light are required in addition to the lights required in Paragraph 2 above.
4. If a vessel engaged in dredging or underwater operations is at anchor then in addition to the light(s) or shape(s) required for vessels at anchor or aground it should display the lights or shapes required in Paragraph 2 above. If an obstruction exists, then in addition the vessel should exhibit:
  - Two all round red lights or two balls in a vertical line to indicate the side on which the obstruction exists.
  - Two all round green lights or diamonds in a vertical line to indicate the side on which another vessel may pass.
5. If the size of the vessel engaged in diving operations makes it impracticable to exhibit the shapes described above then a rigid replica of the International Code flag 'A' not less than 1 meter in height should be exhibited and so displayed that it can be seen from all directions.
6. Vessels of less than 7 meters in length are not required to exhibit the diving lights as described above.
7. The interpretation of the regulations makes it mandatory for all vessels to comply with them. The only offshore installations not so affected are permanently fixed platforms which, once they have been placed in position, are no longer vessels. However, it may be considered prudent for fixed platforms to conform. In addition, Installation Managers of fixed platforms should ensure that all vessels in the vicinity are warned by any means possible that divers are operating from the installation or from any smaller craft close to the installation.







## SECTION 8.0

# MINIMUM REST HOUR POLICY





## 8.0 MINIMUM REST HOUR POLICY

### 8.1 INTRODUCTION

Sufficient data is available to clearly document that more than 80% of accidents are caused by human error.

### 8.2 BACKGROUND

Historically, the commercial diving community—like many other segments of industry—has approached safety from a predominantly technical perspective. Conventional wisdom has depended upon engineering, as a technological solution, to promote safety and thereby minimize the risks and consequences of accidents in the work place. Federal and international regulations and standards address equipment requirements, design requirements and technical standards to help improve quality and reliability. However, despite industry innovations, accidents continue to persist.

### 8.3 CAUSATIVE FACTORS

Reliable data backed by extensive statistical analysis has been presented to classify human errors into the five categories shown below:

#### 8.3.1 Management

This error category deals with policy and procedures and includes items such as “insufficient manning,” “inadequate communications or coordination,” and “faulty standards, regulations, policies or practices.” The most frequently cited management errors involve faulty standards and regulations, and inadequate communications or coordination.

#### 8.3.2 Operator Status

Errors attributable to operator status, which characterizes worker attributes, includes such items as fatigue, inattention, vision deficit, and workload. Inattention or carelessness and fatigue were commonly cited errors.

#### 8.3.3 Working Environment

This category describes errors caused by the natural and job site working environments, and includes items such as “hazardous natural environment,” “poor human factors equipment design,” “poor maintenance,” and “inadequate information.” Poor equipment design and a hazardous natural environment were the most commonly cited errors.

#### 8.3.4 Knowledge

The fourth error category, knowledge errors, deals with the worker’s knowledge and experience, and includes items such as “inadequate general technical knowledge,” “inadequate knowledge of equipment capabilities,” and “unaware of role/task responsibility [actual job requirements at the worksite].”

#### 8.3.5 Decision Making

The fifth category - decision making, includes items such as “faulty understanding of current situation,” “decision based on inadequate information,” and “not prudent workmanship.” Decision making errors based on poor judgment and based on inadequate information were more frequently cited.



Comment: Only two of the above major categories, operator status [8.3.2] and decision making [8.3.5], represent what is commonly captured as “operator error,” and contribute to more than half of the errors attributable to the other error categories.

Background: Human errors cause more than 80% of maritime casualties. Commercial diving operations can lead to situations where personnel are required to perform work far beyond the limits of reasonable human endurance. Such action can, and does, lead to human errors by virtue of sleep deprivation, depletion of energy, etc.

## 8.4 POLICY DEVELOPMENT

Companies providing services in the commercial diving industry are furnished no guidance by state or federal regulations related to “minimum rest hour policy.” Frequently, members of dive teams are required to perform various job related functions over extended periods of time with one phase of activity running into the other with no interruption. Some examples of these are:

- loading equipment for deployment to the jobsite
- transporting equipment and personnel to the job site by land
- transiting to the job location by boat or helicopter
- setting up equipment at the dive station

Yet often, even with the dive station set up, members of the dive team will encounter further delays in actually commencing operations due to circumstances beyond their control.

The net result of the above is that too often members of the dive team are expected to immediately commence operations at the direction of the client/customer who does not realize that those persons may have already been working for extensive periods beyond twelve hours and may thus arrive at the job site in an already rest deprived condition. Thus; those persons have already fallen into two (2) of the five (5) major categories which contribute to in excess of fifty percent of accidents attributable to human error. [Operator Status and Decision Making]

## 8.5 ADCI POLICY

The Association of Diving Contractors International, in keeping with its Charter to promote Safety, Education and Communication throughout the commercial diving industry, considers that from time to time it is appropriate and necessary to propose consensus guidelines intended to contribute to a reduction of accidents and improved working conditions for persons active in the commercial diving industry. Accordingly, the ADC Safety, Medical and Education Committee, at the request of the Board of Directors, was asked to develop such a policy. Set forth hereafter is the policy which incorporates comments and suggestions received from the ADC membership between the period 28 August through 24 November 1996 and which, from 25 November 1996, is established as an ADC Standard.

## 8.6 COVERAGE

This policy is intended to apply to all members of the operating dive team including Diving Supervisors, Divers, Life Support Technicians, and Tenders. Excluded from this policy are persons falling into the contractors management category such as those performing duties of a Project Manager, Project Superintendent, Diving Superintendent, or other individual whose activities are not required to take place at the actual dive station during a regularly scheduled shift/watch.

## 8.7 MINIMUM REST

Diving operating personnel may work no more than 18 continuous hours when that work includes loading equipment; traveling to the job site by air, land, or sea; setting up the dive station, standing by to commence diving operations, participating in diving operations or, any combination of same. After 18 continuous hours of performance such persons must be provided a minimum of 8 consecutive hours away from the dive station and engaged in no alternate work activity.

Excluded from the above would be any hours during the initial 18 hour period where diving operating personnel may have been afforded an opportunity for an uninterrupted period of sleep in excess of four (4) hours. That opportunity may be considered to have been afforded during such times as during transport to the job site by land, sea, or air.

When duty at the dive station does not include activities under paragraph 1 and 2 above, diving operating personnel will not be permitted to work more than 16 hours in any 24 hour period or, 60 hours in any 96 hour period, except in an emergency. Furthermore, such persons must be given at least 8 consecutive hours off duty between work periods.

An emergency exists when a direct threat to the continued health and well being of the individual(s), or a significant loss of property may take place as the direct result of an unplanned event.





## SECTION 9.0

# ACCIDENT REPORTING







## 9.0 ACCIDENT REPORTING

### 9.1 INTRODUCTION

For over 32 years ADCI has pursued the goal of promoting safety throughout the commercial diving and underwater industry. During this period certain standards have been established to supplement or amplify regulatory provisions directed to the performance of underwater activities involving commercial divers. These standards are widely recognized for their excellence and applicability to the goal of improving the safety associated with commercial diving.

An absence of factual information regarding the number of reportable casualties that annually occur impacts the overall mission of ADCI. Various efforts have been made throughout the years to develop a mechanism to analyze these accidents to a particular industry sector, geographic region, or type of activity. However, all have failed due to issues of sensitivity, concern over legal action, misreporting of the facts, or other issues. Furthermore, reports submitted directly to regulatory authorities are difficult to obtain in a timely manner in order to notify member companies of potential safety issues of which they should be aware.

#### 9.1.1 Federal Regulatory Requirements

##### 46 CFR – Department of Transportation – Coast Guard

Subchapter V-Marine Occupational Safety and Health Standards, Part §197.484, requires the Person in Charge to notify the Officer in Charge, Marine Inspection, as soon as possible after a diving casualty occurs, if the casualty involves any of the following:

- Loss of life.
- Diving-related injury to any person causing incapacitation for more than 72 hours.
- Diving-related injury to any person requiring hospitalization for more than 24 hours.

Part §197.486 defines the form of the written report of casualty and requires:

- That a report be furnished on Form CG-2692 when the diving installation is on a vessel or,
- That a written report, in narrative form, be used when the diving installation is on a facility.

In either instance, the report must furnish the following information:

- Name and official number (if applicable) of the vessel or facility,
- Name of the owner or agent of the vessel or facility,
- Name of the Person in Charge,
- Name of the Diving Supervisor,
- Description of the casualty including presumed cause
- Nature and extent of the injury to persons.

#### 9.1.2 29 CFR – Department of Labor – Occupational Safety and Health Administration

Subpart T – Commercial Diving Operations, §1910.440, requires that an employer record the occurrence of any diving-related injury or illness which requires any dive team member to be hospitalized for 24 hours or more, specifying the circumstances of the incident and the extent of any injuries or illnesses.

In May 1994, OSHA further clarified and defined the reporting requirement to state:

Employers are required to orally report any occupational fatality or catastrophe involving in-patient hospitalization of three or more workers within eight hours per 29 CFR §1910.8. The report must include the following information:

- Company name
- Location and time of incident
- Number of fatalities or hospitalized employees



- Contact person for the company
- Phone number(s) for the company contact person
- Brief description of the incident.

### **EXEMPTIONS FROM FATALITY AND CATASTROPHIC ACCIDENT REPORTING DO NOT EXIST!**

Even though most commercial diving companies are exempt from recordkeeping requirements (SIC7389), all are required to:

- Orally report as defined above
- Maintain a log of occupational injuries and illnesses.

#### **9.1.3 Association of Diving Contractors International Requirements**

ADCI cannot require its general member companies to report fatalities/catastrophic injuries for those members who joined the organization prior to June 2000. However, for those who joined subsequent to that date, reporting is a requirement accepted as a part of the membership application.

Notwithstanding the above, ALL general member companies are strongly urged to comply with the following procedure in support of our mutual industry goals. In the absence of having valid and factual information, ADCI will continue to be faced with an inability to properly respond to requests from legitimate interested parties regarding our incident rates and safety performance as an industry—at least, as represented by our membership!

#### **9.1.4 Procedures**

ADCI member companies are urged to furnish ADCI with a copy of any report required by either 29 CFR or 46 CFR. In those instances, where the report is initially submitted in an oral format (29CFR), furnish to ADCI information derived from log entries required by that regulation. Reports should be furnished to ADCI at the same time as submitted to regulatory authorities to ensure that ADCI is able to properly respond to enquiries regarding the actual circumstances rather than having to rely upon media releases that often are inaccurate or embellished.

It is NOT the intent of ADCI to disclose identities of companies, individuals, or circumstances contained in reports received, unless these are commonly known as perhaps having been disclosed through a press release or safety notice by the company involved. The PURPOSE of the “system” is to gather information that can then be used in developing accurate statistical data, or where information received may warrant development of a safety notice or other guidance document intended to promote improved safety. The contents of reports may also be used to defend our industry from the actions of unscrupulous parties whose goals are clearly only those of defamation.



# ACCIDENT REPORT

To: Association of Diving Contractors International  
www.adc-int.org or,  
281-893-5118

From: \_\_\_\_\_  
Company Name

Subject: Casualty Report

Date of incident: \_\_\_\_\_

Location of incident: \_\_\_\_\_

Description of event: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Nature and extent of injury(s):



## 9.2 ACCIDENT RECORDING

### 9.2.1 Reporting

A detailed description of all occupational injuries and illnesses shall be recorded.

### 9.2.2 Retention of Records

Reports and medical records shall be retained for five years except where otherwise mandated by law.

## 9.3 ADCI SAFETY STATISTICS REPORTING STANDARDS

### 9.3.1 Introduction

The Safety Statistics Reporting Standards provide a uniform reporting scheme for all members. They define and clarify items in the **ADCI Incident Data Reporting Form** for reporting accident data requested by the customers.

These definitions are based on OSHA reporting guidelines, but are not in complete conformance with OSHA. Operators want to compare members with other members, not other subcontractors in different industries. Therefore, these consensus safety reporting guidelines are formulated to be clear, concise, and easily understandable. They apply specifically to the offshore diving industry's unique situation.

Diving contractors who are subject to OSHA record-keeping requirements should use strict OSHA reporting guidelines when recording incidents on the **ADCI Incident Data Reporting Form**.

The **ADCI Accident Classification Flowchart** is used to quickly determine whether an incident is reportable, and if so, what its classification is. The detailed information below explains the reporting scheme in further detail.

### 9.3.2 Scope and Application

#### **Area of Coverage**

Incident statistics and hours worked are reported for North American operations only. No foreign data is to be considered under these guidelines. Furthermore, only statistics for the area over which the person reporting has control should be submitted. The criteria for reporting is control and access to information. An office that dispatches divers for an area has daily counts of men offshore, and accident reports from those employees will report for that operation. The individual responsible for submitting the data must state on the form what areas are represented. All incidents must be reported for all personnel whose hours are included in the "Total Hours Worked" columns.

#### **Applicability**

The **ADCI Incident Data Reporting Form** reports information in two sets, for "Diving Operations" and "Total Company."

#### ***Diving Operations***

The basic criteria for determining who to include in this division is control. Report incidents and man hours for all personnel under direct control of the Diving Supervisor in charge. If non-diving personnel are accountable and report to the Diving Supervisor, then count them. If they report to someone else, then do not report them under "Diving Operations." It is assumed that all members have an operations board or report showing daily men working for customers on different jobs. This is an easy and uniform way to determine personnel and hours. Records of daily totals can be kept and used to compute hours worked.

**Total Company**

This is a total representing all company divisions, such as ROV, construction, marine, shop, office, etc. Diving operations totals are included in these figures. Again, all incidents must be reported for all personnel included in the “Hours Worked” totals.

## 9.4 INCIDENT CLASSIFICATION AND DEFINITIONS

### 9.4.1 Work-Related Incident or Illness

This includes all incidents or illness that occur while the offshore employee is on deck, on shift, or under pressure. It includes shop incidents occurring on duty at the current job site, and relating to job performance. Do not include incidents relating to recreational activities, travel, or non job-related activities such as eating. Also do not record non job-related illnesses such as colds, diseases of a communicable nature, insect stings, etc. Marine animal stings, diving-related ear infections, contact dermatitis from job-related chemicals, etc. are reportable.

### 9.4.2 Reportable Incident

The basic guideline for this category is to decide whether the incident required treatment by a licensed physician. If the incident never results in a medical expense and is not a bends case, then it is clearly non-reportable. If the employee receives treatment from a licensed physician that could legally have been performed by a nurse or technician, then it is non-reportable. If antibiotics or other prescriptions were administered one time only, and if the incident meets all other criteria, then it is non-reportable. Negative X-rays, eye flushes, and one-time-only physiotherapy are also non-reportable. Stitches, removal of embedded material from eye or wound, and a second doctor visit other than for purposes of examination and release are reportable. Any other circumstances can be determined by referencing the current OSHA “Record-Keeping Guidelines for Occupational Illness and Injuries.”

### 9.4.3 Hours Worked

For the purposes of these standards, hours shall be calculated according to the following:

- **Offshore**  
Man-Days x 24 hours
- **Shop**  
Man-Days x 12 hours
- **Office**  
Man-Days x 8 hours (40 hrs./employee/week)

### 9.4.4 Lost Time Accident or Illness (LTA)

This is a work-related accident or illness that results in an employee being unable to perform any work whatsoever for 24 hours or more, not counting the day of the incident or the day the employee returns to work. For offshore personnel not working a regularly scheduled work rotation but serving on a call-out basis, the accident shall not be considered to be lost time if he comes onshore with the rest of the crew at the end of the job, or one day only before the last day of the job, if he can return to work within 72 hours. If the employee has regularly scheduled crew changes and comes in on his normal crew change day, or one day before, then it shall not be considered lost time, provided he is able to return to work within 72 hours not counting the day of the incident.



#### 9.4.5 Restricted Activity Accident or Illness (RIA)

This is a work-related accident or illness that results in an employee being unable to perform the full range of activities to which he was assigned for that job. The same time considerations for lost time accidents apply to restricted activity. If the diver is able to work in the shop or on deck in his restricted capacity even though there may not be work for him, then he can be classified as RIA. OSHA specifies that it is the employer's decision as to whether the employee is workable.

#### 9.4.6 Non-Disabling Accident or Illness

This is a reportable incident that is not lost time or restricted activity.

#### 9.4.7 Bends

##### **Pain Only Bends (Type 1)**

If treatment offshore is successful and all symptoms are resolved, then the bends is not-reportable. Totals of all Type I bends should be displayed in the "Type I" column of the reporting form, but not included in the total for non-disabling incidents for "Diving Operations" and "Total Company."

##### **Serious Symptom Bends (Type 2)**

If all symptoms are resolved on site, and no further onshore hyperbaric treatment is necessary, the incident is classified as "Restricted Activity" even though the diver must be examined by a doctor. If further onshore hyperbaric treatment occurs, then the incident is to be considered "Lost Time."

#### 9.4.8 Number of Dives

Each time the diver enters the water, submerges, and returns to the surface, is to be considered one dive. Repet-ups are only one dive. Saturation exposures are to be considered as number of dives equals man days seal to seal.

#### 9.4.9 Total Recordable Incidents

This is the sum of all work-related "Lost Time," "Restricted Activity," and "Non-Disabling Incidents."

#### 9.4.10 Incident Rates

The incident rate is calculated for "Lost Time Accidents" and for "Total Reportable Incidents." This is OSHA's method of obtaining a ratio of incidents per hours worked. It represents the total number of incidents equated to one hundred employees working forty hours per week for a fifty-week year. The ADCI **Incident Data Reporting Form** has four incident rates to be calculated. "Lost Time" and "Total Recordable Incident" rates are calculated for both the diving operation only and the whole company.

The method of calculation is given by the formula:

$$\text{Incident Rate} = \frac{\text{Number of Incidents} \times 200,000}{\text{Hours Worked}}$$

#### 9.4.11 Accident Classification Flowchart

The accompanying **ADCI Accident Classification Flowchart** assists in the application of the foregoing definitions and should be used in classifying all incidents.

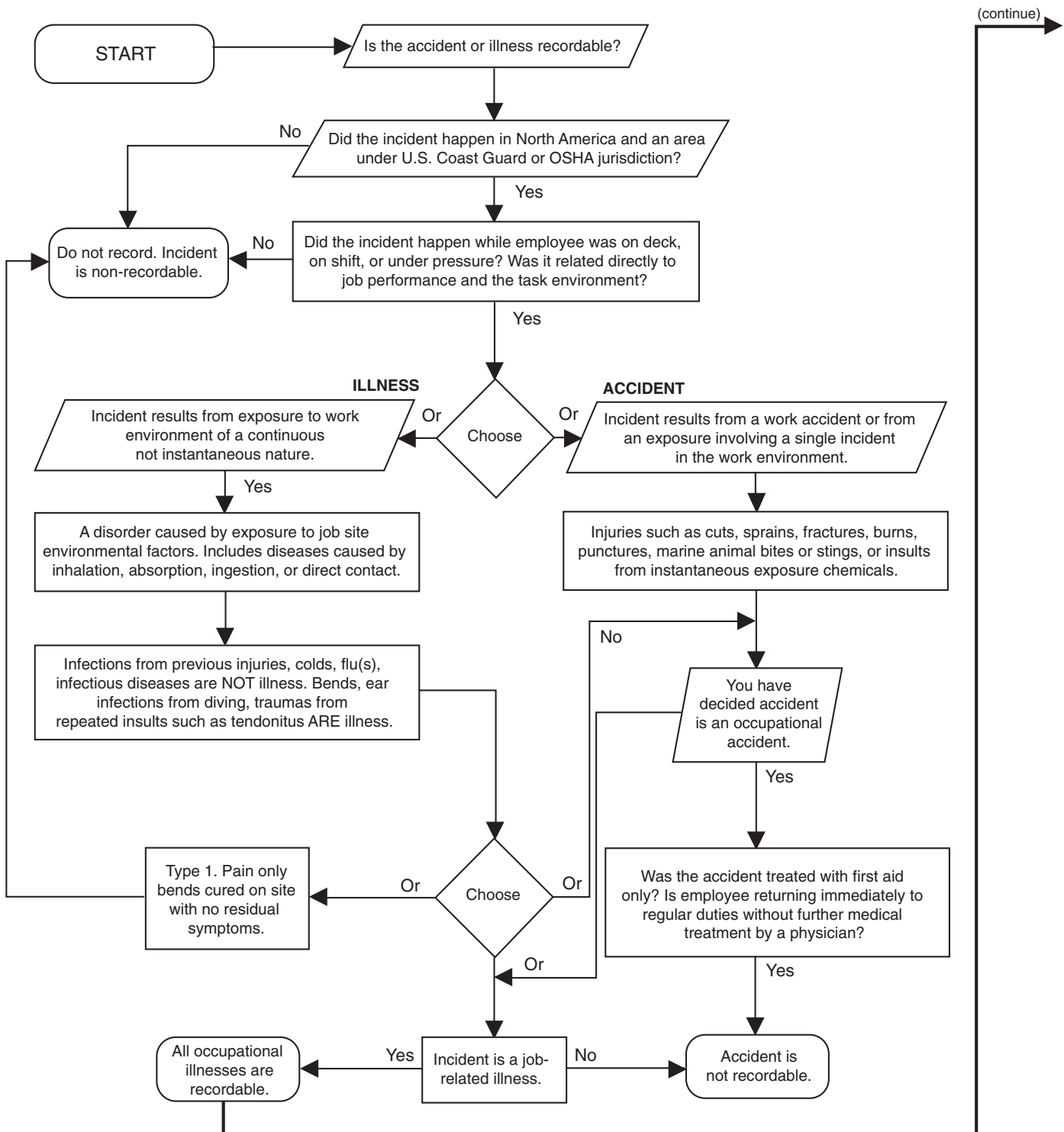
#### 9.4.12 ADCI Incident Data Reporting Form

The accompanying **ADCI Incident Data Reporting Form** shall be used for reporting incident data in response to requests for safety information. Additionally, ADCI will request all ADCI contractors to respond anonymously with their incident data forms once each year. Responses to the survey will be analyzed and reported in *Underwater Magazine*. This will give members the opportunity to compare their safety record with industry averages.

The enclosed form may be photocopied and used for a supply, or may be reproduced electronically by personal computer.

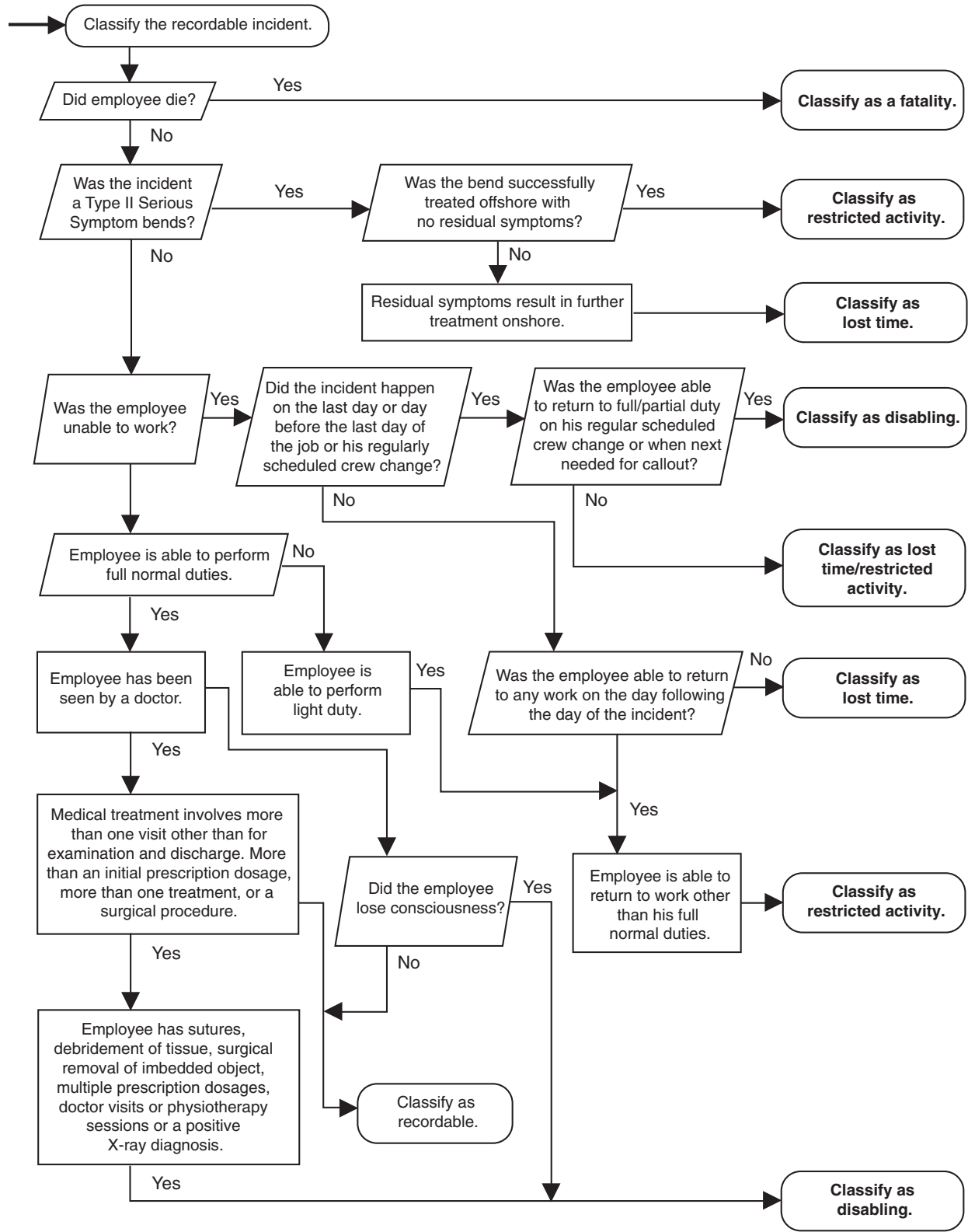


## ADCI—Accident Classifications Flowchart





## ADCI—Accident Classifications Flowchart (continued)





# INCIDENT DATA REPORTING FORM

PERSON COMPLETING FORM:	
COMPANY:	
TITLE/POSITION:	
DATE COMPLETED:	
PHONE:	

INCIDENT RATE =  $\frac{\text{NUMBER OF INJURIES/ILLNESS} \times 200,000}{\text{HOURS WORKED}}$

ON SITE DIVING OPERATIONS WITHIN NORTH AMERICAN WATERS UNDER U.S. COAST GUARD/OSHA JURISDICTION										U.S. COAST GUARD/OSHA RECORDABLE INCIDENTS TOTAL COMPANY FOR ALL NORTH AMERICAN DIVISIONS					
FATALITIES	LOST TIME	RESTRICTED ACTIVITY	NON DISABLING	TYPE I DCS PAIN ONLY SEE NOTE 1	TYPE II DCS SERIOUS SEE NOTE 2	INCIDENT RATES FOR DIVING OPERATIONS		DIVING OP's TOTAL HOURS WORKED YEAR OR YTD	FATALITIES	LOST TIME ACCIDENTS	RESTRICTED ACTIVITY	NON DISABLING	INCIDENT RATES COMPANYWIDE		COMPANYWIDE TOTAL HOURS WORKED YEAR OR YTD
						LOST TIME	TOTAL RECORDABLE						LOST TIME	TOTAL RECORDABLE	
SECTION I INCIDENT HISTORY PAST YEAR 20__															
SECTION II INCIDENT HISTORY PAST YEAR 20__															
SECTION III INCIDENT HISTORY PAST YEAR 20__															

NOTE 1	NOTE 2	NOTE 3
SYMPTOMS RESOLVED ON SITE DO NOT INCLUDE IN NON DISABLING COLUMN	IF NO ONSHORE TREATMENT CLASSIFY AS RESTRICTED ACTIVITY OTHERWISE LOST TIME	ONE DIVE L/S TO R/S FOR SAT DIVES COUNT NUMBER OF MAN DAYS SEAL TO SEAL

DEFINITIONS: LAST YEAR: JANUARY 1, 20\_\_ THRU DECEMBER 31, 20\_\_  
PAST YEAR: JANUARY 1, 20\_\_ THRU DECEMBER 31, 20\_\_

**RECORDABLE INCIDENT:** AN ACCIDENT OR WORK-RELATED ILLNESS REQUIRING TREATMENT BY A LICENSED PHYSICIAN AS DEFINED BY THE OSHA RECORD-KEEPING GUIDELINES FOR OCCUPATIONAL INJURIES & ILLNESS (SEPTEMBER 1995).

**LOST TIME INCIDENT:** A WORK-RELATED ACCIDENT OR ILLNESS THAT RESULTS IN AN EMPLOYEE BEING UNABLE TO PERFORM ANY WORK FOR 24 HOURS OR MORE, NOT COUNTING THE DAY OF THE ACCIDENT OR THE DAY HE RETURNS TO WORK.

**RESTRICTED ACTIVITY:** A WORK-RELATED ACCIDENT OR ILLNESS THAT RESULTS IN AN EMPLOYEE BEING UNABLE TO PERFORM THE FULL RANGE OF DUTIES ASSIGNED TO HIM FOR THAT JOB FOR 24 HOURS OR MORE, NOT COUNTING THE DAY OF THE INCIDENT OR THE DAY HE RETURNS TO WORK.



## SECTION 10.0

# PRESSURE VESSELS FOR HUMAN OCCUPANCY





## 10.0 PRESSURE VESSELS FOR HUMAN OCCUPANCY

### 10.1 INTRODUCTION

The ADCI in its technical and advisory capacity to the diving industry has adopted a set of guidelines for the repair and maintenance of PVHO equipment that it recommends be incorporated into industry practice.

The diving business is by its nature an industry that operates within a harsh environment. Consequently the design, construction and maintenance of diving equipment and the associated operational procedures are governed by Industry and National Standards, as well as National and International Regulations (Appendix A). PVHO hardware, and associated systems are specialized equipment, rules for which were conceived specifically to minimize the risk involved.

An unfortunate fact of life in the diving business, as in any business, is that valuable assets like PVHO's can become damaged. Damage may occur by accident or by nature. It can happen during operations, while in transit, being dropped or having something drop on it. PVHO's have been damaged by fire, over pressurization during periodic testing, or through lack of attention to a needed paint job. The reasons can be many and varied.

### 10.2 GENERAL PRECAUTIONS

These are general precautions for the cleaning, operational inspection, installation and maintenance of acrylic plastic windows used in pressure vessels for human occupancy.

Acrylic plastic windows may deteriorate in service due to exposure to harmful cleaners, high temperatures, long exposures to sunlight or radiation to such an extent that they may lose their optical quality and/or may also induce surface cracks and scratches that may lead to window failure.

#### **Precautions for acrylic windows:**

1. Do not use solvents when cleaning the window or expose to solvent based paints or thinners.
2. Do not expose to high temperatures (above 150°F).
3. Do not expose to high radiation (above four [4] Megrads).
4. Inspect windows before every operation.
5. Use only the gasket, seal and/or O-ring size and material specified on drawings.
6. Ensure seals and gaskets are properly installed using adhesive sealants or lubricants compatible with acrylic window material.
7. Always use care in handling windows.
8. Do not over-pressurize.
9. Keep protective cover on window whenever possible.
10. Avoid exposure to sunlight and/or ultraviolet light sources for extended periods.



## 10.3 CLEANING

When cleaning is required, windows should be carefully cleaned taking care not to scratch any surfaces. Some acceptable cleaning agents are:

- a. Detergent soap and clean warm water (Maximum 120°F).
- b. Aliphatic Napha.
- c. Hexane or equivalent.

**Do not use solvents of any type** (alcohol, acetone, etc.) for any purpose on the window, gaskets or O-rings.

**CAUTION:** Only hand cleaning and/or polishing is allowed. The use of power driven tools is not permitted.

After cleaning, inspect the window for blemishes such as cracks, chips, dings, scratches, crazing, blisters, or discoloration.

## 10.4 IN SERVICE INSPECTION

Operational inspections should be conducted prior to each chamber pressurization. Visually inspect the accessible exterior, interior and bearing surfaces for the presence of blemishes in the form of crazing, cracks, scratches, blisters and discoloration. (Crazing is the development of a network of fine spider web type cracks on the surface of the window, it can be caused by either stress or exposure to solvents.) A common flashlight will assist in locating blemishes such as chips, cracks, or crazing and in determining the condition of bearing surfaces.

Blemishes on the low pressure face can serve as initiators of cracks and subsequent failure in flat disk and conical frustum windows. For diving bells and submersible diverlock-out compartment windows, both faces should be considered as low pressure faces.

The depth of the blemish can be measured with a depth micrometer with a pointed rod (Brown and Sharpe, or equal or an optical comparator). Consideration should be given to the concentration of scratches, cracks or crazing occurring in the center of the viewing area as this may be an indication of stress.

Any window with a crack or scratch deeper than .030 inch, crazing, blisters and discoloration on the low pressure face, should be repaired or replaced.

Blemishes on the low pressure face of a spherical sector window deeper than .060 of an inch are reason for repair or replacement of the window.

Windows with blemishes on the high pressure face greater than .060 of an inch should be replaced.

Blemishes on any conical bearing surface deeper than .060 of an inch are reason for the immediate repair or replacement of the window.

Windows with chipped edges on the high pressure face should be replaced if:

- a. proper sealing is not possible, or
- b. the chip missing is longer than 1" (circumferentially) or deeper than .020 of an inch.

Windows with chipped edges on the low pressure face should be replaced if they are deeper than .030".

## 10.5 MAINTAINENCE INSPECTION

Maintenance inspections should be conducted at least once every 12 months.

This inspection involves the complete disassembly of the window assembly. The window, seals, sealing and bearing surfaces should be cleaned, inspected, reassembled, and pressure tested.

If gaskets or O-rings show any damage, hardening or wear, they should be replaced. If replacement is not necessary, a thorough cleaning and re-lubrication is sufficient.

## 10.6 INSTALLATION

Viewports should be properly cleaned and carefully installed to ensure proper fit and safe operation. All window surfaces should be free of defects.

All metal contact surfaces must be smooth and clean. Surface should be free of all defects and foreign matter. Halocarbon 25-5S, Fluorolube, Krytox or equivalent oxygen compatible lubricant, which is compatible with acrylic, should be used. Retaining bolts should also be cleaned, inspected, and lubricated.

O-ring and gasket sealing surfaces must be completely free of any foreign material, such as: cleaning agents and solvents, rust, sand, grit, paint chips, etc. All paint which will come in contact with the window should be fully cured.

## 10.7 MARKINGS

Window identification markings must be preserved on each window during cleaning and handling. Corresponding window documentation should be maintained with the PVHO documentation package.

**NOTE:** Further information can be found in ANSI ASME/PVHO-1, Section 2.

## 10.8 DAMAGE BY ACCIDENT

Major structural damage may be caused by an accident or mishandling. This may include things like:

### 10.8.1 Pressure Hull Damage

- Dents
- Gouges
- Damaged penetrator (stripped threads)
- Mating flange
- Lift lug or tie-down eye (bent, broken or hole elongation)
- Support base (frame deformation)

### 10.8.2 Doors

- Damaged sealing surface
- Bent/broken hinge
- Damaged dogging mechanism

### 10.8.3 Window Damage (See ADCI Standard 02)

- Crazing
- Cracked /Chipped
- Weld spatter
- Paint thinner damage
- Overheated / blistered ( permanent deformation )

## 10.9 DAMAGE BY CORROSION

**10.9.1** More important than damage done by an accident, and often unseen until more extensive, is the damage done by corrosion. Most damage by corrosion can be avoided with a diligent preventative maintenance program, however, with the best P.M. programs damage can still occur.



### 10.9.2 Typical Corrosion Damage May Include:

- Pit corrosion ( shell and heads )
- Crevice corrosion
- Penetrator's
- Viewport window sealing surfaces
- Door faces
- Sealing surfaces
- O-ring grooves
- Support legs/saddles

### 10.9.3 Corrosion Allowance

Pressure vessels are typically built with a corrosion allowance in the calculated required metal thickness. This information is usually found on the pressure vessel certificate. Examination of corrosion affected areas should be done in a manner necessary to determine if the corrosion has gone beyond the calculated allowable, and may require remedial action.

## 10.10 REPAIR OF A PVHO

The owner should be aware of the requirements of the regulatory authority and of interested third parties, as their requirements will have a direct bearing on the repair specification.

If you don't approach the repair properly, regardless of how well the work is done, or the quality of the material used, without a conscious effort to comply with existing rules and regulations it is possible to have an expensive repair that does not meet the requirements and is unacceptable.

It is important that a defined method is used when approaching the repair of a PVHO. Recommended steps for approaching any repair are as follows:

- Appraisal
- Plan
- Execution
- Documentation

## 10.11 APPRAISAL

1. The initial step, while it may seem obvious, is to appraise the damage. This means more than a casual look at the vessel and agreeing that it has been damaged. All damage should be investigated as to the cause and to determine what measures can be taken to prevent a reoccurrence.
2. Measure or otherwise quantify the damage so you can answer questions about the extent of the visible damage. Be aware that there may be areas of hidden damage. Make a sketch or map of the damaged area, photos may be helpful. Make a written report, describing the nature and extent of the damage. Be accurate and include as much detail as possible. Be honest in your appraisal, remember that the goal is to save the PVHO vessel and to put it safely back into service.
3. Damage to the pressure boundary of the vessel will require that any repairs be done in accordance with the code of manufacture. Likewise, damage to the attached piping shall be repaired to the code to which it was built. Only components meeting the applicable code requirements should be used for repairs or replacements.



4. Gather up all of the existing documentation on the vessel. This information will be needed by engineering, code repair shop, authorized code inspector, insurance adjuster, classing society surveyor, etc.
5. Depending on the type and extent of damage it may be necessary to call in a non-destructive test inspection (N.D.T.) to determine the extent of damage. It may be necessary to grit blast the vessel to bare metal to determine the exact scope of work.
6. Prepare a written report and budget for the repairs.

**NOTE: If the decision as to the disposition of the repair is yours to make—don't skip this step! It will become your tool to control the repair project.**

## 10.12 PLAN

1. Make a technical plan for the repair. The plan should clearly establish the scope of work for the fabricator, as well as the scope of responsibility. This plan, if correctly drawn up, can function as the specification for the work and as part of a purchase order.
2. The plan should clearly state the codes, standards, rules, regulations, and quality of workmanship that will govern the work. Don't forget the paperwork requirements. Be very specific about the paperwork and paper deliverables for which the fabricator or repair shop is responsible.
3. Prepare, or cause to be prepared by others, the drawings and/or calculations as necessary to effect the planned repair. An engineer, either in-house or outside, may need to be engaged to verify all details have been addressed.  
You should then obtain agreement from the regulator (jurisdiction) or classing society that:
  - The proposed repairs and techniques are within the code
  - The proposed materials meet the code requirements
  - The repair plan will be approved

Most repairs will require an initial survey to look at the vessel and to assess your repair plan.

## 10.13 EXECUTION

1. Having obtained the concurrence of the required parties, and armed with your repair plan, budget, drawings and specifications, you are now ready to talk with a qualified fabricator or repair shop.
2. The least problematic choice is the original vessel fabricator. This is not always possible, but the likelihood is that they will have the records which will make the repair and documentation go smoother.  
Unfortunately, many of the fabricators that have built PVHO's in the last 15 years are either out of business or may not have retained the records on your vessel. The ASME only requires records to be retained for 5 years. It is a good idea to require as part of your purchase agreement with any fabricator or repair facility that you receive a copy of all paperwork.  
If the vessel was registered with the National Board of Pressure Vessel Inspectors you can get copies of the certificate by contacting the National Board.



3. The next best choice would be a fabricator that is currently building and certifying PVHO vessels. The fabricator should be authorized to apply the ASME "U" stamp and/or the "R" stamp from the National Board. The scope and criteria to differentiate between minor and major repairs is provided in the National Board Code ANSI- NB23. Alternatively, for PVHO's constructed to other codes, the repair shop should be certified to do repairs to the code to which the PVHO vessel was built.

## 10.14 TESTING

1. Prior to, during, and after repairs various types of testing may be employed.
2. Test results should be retained as part of the equipment record.
3. All Non-Destructive Testing should be done in accordance with ASME Section-V, "Non Destructive Examination" by personnel competent in the type of test employed.
4. Pressure tests should be done in accordance with a written procedure and appropriate safety precautions.

## 10.15 DOCUMENTATION

1. All repairs and alterations are to be recorded in the Equipment Log. This should be accompanied by references to certificates and identification markings. Pressure testing should likewise be documented and recorded in the log. Any alteration or modification should be reflected in all drawing revisions.
2. All certificates, drawings, calculations, and reports should be retained for the service life of the equipment.

**A professional approach to the repair of PVHO's will yield professional results, thereby preserving a valuable asset and ensuring the safety of the occupants and operators.**

**It is impossible to guarantee that accidents will not happen. However, the probability can be significantly reduced by a good PREVENTATIVE MAINTENANCE PROGRAM and consistent safe practices.**

## APPENDIX 10.A

- ASME Boiler and Pressure Vessel Code Section VIII Division 1 & 2
- ASME Section V Non Destructive Examination
- ANSI — ASME/PVHO-1 Safety Standard for Pressure Vessels for Human Occupancy
- ANSI B31.1 Code for Pressure Piping, Power Piping
- Association of Diving Contractors Consensus Standards for Commercial Diving Operations
- 29 CFR Part 1910 OSHA rules for Commercial Diving
- 46 CFR Part 197 USCG rules for Commercial Diving Operations
- IMO (International Maritime Organization) Code of Safety for Diving Systems a.536(13)
- IACS (International Association of Classing Societies)
  - ABS ( American Bureau of Shipping)
  - DNV ( Det Norske Veritas)
  - Lloyds Registry
- National Board of Boiler & Pressure Vessel Inspectors ANSI-NB23



## SECTION 11.0

# HANDLING SYSTEMS





## 11.0 HANDLING SYSTEMS

### 11.1 SCOPE

Guidance on the design, installation, and testing of handling systems for the launch and recovery of divers

### 11.2 GENERAL

Handling systems intended for the launch or recovery of a diver or divers between the surface dive location and the work location by either bell or stage shall:

1. Be designed, manufactured, installed and tested in accordance with all applicable design codes, standards, and regulations.
2. Be designed such that the drive system and not the brakes control operation under normal conditions.
3. Be fitted with a mechanical brake capable of holding 1.25 times the Safe Working Load of the winch.
4. Be designed so that the load can be stopped, and held in position, if the power supply fails, is disengaged, is switched off, or operating control is released.
5. Have controls located or equipped such as to afford the operator both a view and control of the lifting operation.
6. After any installation, alteration, repair, or failure be thoroughly examined and be functionally and load tested to 1.25 times the safe working load of the handling system.
7. Have wire ropes and fittings that are:
  - Installed, terminated and maintained in accordance with design criteria and/or manufacturer's recommendations.
  - Visually inspected every 6 months for damage, deterioration or deformation.
  - Periodically examined and tested to recognized applicable codes and standards.
  - Have wire ropes and fittings that are rated 8 times the system safe working load.
8. If the bell umbilical is to be used as part of the recovery system, have the umbilical termination designed for that service.
9. Have a spooling arrangement fitted if fleeting angle exceeds 2 degrees.



## 11.3 REFERENCES

1. ADC Consensus Standards for Commercial Diving and Underwater Operations
2. 46 CFR Part 197 USCG rules for Commercial Diving Operations
3. 29 CFR Part 1910 OSHA rules for Commercial Diving Operations
4. American Bureau of Shipping Rules for Building and Classing Underwater Vehicles, Systems, and Hyperbaric Facilities - Appendix D.
5. Lloyds Register Rules and Regulations for the Construction and Classification of Submersibles and Underwater Systems Part 5, Chapter 7.
6. Norske Veritas Rules for Certification of Diving Systems Section 7.
7. American Petroleum Institute RP 2D Recommended Practice for Operation and Maintenance of Offshore Cranes.
8. IMO (International Maritime Organization) Code of Safety for Diving Systems.



## SECTION 12.0

# COMMERCIAL DIVING IN POTABLE WATER FACILITIES







## 12.0 COMMERCIAL DIVING IN POTABLE WATER FACILITIES

### 12.1 SCOPE

ADCI Standard 11-1999 is issued to furnish guidance to water utility authorities that use divers to conduct underwater inspections of potable-water facilities. This process allows the facility operator to conduct an underwater inspection to minimize water wastage and downtime associated with necessary storage-facility maintenance.

Research by the ADCI and member companies have clearly identified a large number of potable-water facilities where diving operations are being conducted by improperly trained personnel; with minimal regard for safety, and in flagrant violation of applicable Federal and State regulations for the conduct of commercial diving operations.

Therefore, the Association of Diving Contractors International, in cooperation with the American Water Works Association has worked to develop this Standard. By promulgation of Standard 11-1999 guidance is furnished regarding the legal requirements surrounding the conduct of commercial diving operations and further; associated risk and exposure that may develop should an accident occur, minimized.

This Standard is not intended to address detailed action with respect to disinfection procedures. Those are, in the opinion of ADCI, best addressed by language contained in AWWA Standard C652-92.

### 12.2 GENERAL

Commercial diving operations conducted in potable water reservoirs and storage tanks present a unique set of requirements. Not only must disinfection of diver personnel and equipment be considered, but also many other factors come into play. Nearly all water reservoirs require that confined space entry procedures be used. Access to the top of tanks and reservoirs perhaps hundreds of feet off the ground present an obvious hazard. To compound the situation, there is a lack of knowledge by utility operators as to what is the safe and proper method of accomplishing the intended work. These all serve to present variables of an unknown nature to those not familiar with proper procedures.

The Intent of this Standard is to address some of the more obvious requirements necessary for the conduct of safe commercial diving operations in potable water tanks and reservoirs; requirements that are consistent with Federal regulations to which the States must adhere.

**This Standard should serve to replace Section 5: DISINFECTION PROCEDURES WHEN CONDUCTING UNDERWATER INSPECTION OF POTABLE-WATER STORAGE FACILITIES of ANSI / AWWA Standard C652-92.**

### 12.3 REFERENCE REQUIREMENTS

The following regulatory requirements, standards, and procedures shall apply to the conduct of commercial diving operations in potable water facilities:

1. U.S. DEPARTMENT OF LABOR [OSHA], 29 CFR, Subpart T - Commercial Diving Operations - §1910.401 through §1910.441
2. U.S. DEPARTMENT OF LABOR [OSHA], 29 CFR, 29 CFR, Permit Required Confined Spaces, §1910.146
3. ASSOCIATION OF DIVING CONTRACTORS INTERNATIONAL [ADCI] Consensus Standards For Commercial Diving Operations, Current Edition



4. ASSOCIATION OF DIVING CONTRACTORS INTERNATIONAL Standard 11-1999, COMMERCIAL DIVING IN POTABLE WATER FACILITIES, Current Edition
5. ANSI/AWWA D101-53 (R86) - AWWA STANDARD FOR INSPECTING AND REPAIRING WATER TANKS, STANDPIPES, RESERVOIRS AND ELEVATED TANKS FOR WATER STORAGE. PARTS A&B
6. ANSI/AWWA C652-92, AWWA STANDARD FOR DISINFECTION OF WATER STORAGE FACILITIES - **Exclusive of Section 5.**

**Note: ANSI / AWWA C652-92 shall apply with regard to disinfection procedures and shall be the governing document in that respect.**

## 12.4 JURISDICTION

Federal and State OSHA regulations apply whenever an employer-employee relationship exists within the jurisdiction of OSHA. The jurisdiction of Federal OSHA applies in all areas of the United States and territories except where the State or the Territorial Government have adopted regulations that, as a minimum, contain all of those provisions of Federal OSHA regulations.

## 12.5 APPLICABILITY

OSHA §1910.401(a)(2) states that "This standard applies to diving and related support operations conducted in connection with all types of work and employment." Exempt from this are:

- Diving performed solely for instructional purposes, using open-circuit, compressed air SCUBA and conducted within the no-decompression limits;
- Performed solely for search, rescue, or related public safety purposes by or under the control of a governmental agency or;
  - **Note:** defined as for the immediate purposes of preventing an accident or loss of life—not for accomplishment of routine commercial diving activity in support of the governmental agency!
- Defined as scientific diving and which is under the direction and control of a diving program.

## 12.6 MINIMUM MANNING STANDARD

OSHA §1910.410 (a)(1) states that:

- Each dive team member shall have the experience or training necessary to perform assigned tasks in a safe and healthful manner.
- All dive team members shall be trained in cardiopulmonary resuscitation and first aid (American Red Cross standard course or equivalent). (a)(3).
- Dive team members who are exposed to or control the exposure of others to hyperbaric conditions shall be trained in diving-related physics and physiology. (a)(4).

OSHA Letter of October 29, 1996 furnishes an interpretation of the OSHA Commercial Diving standards (29 CFR Part 1910, Subpart T), that states.

In establishing the required number of dive team members required for a particular situation, proper consideration must be given to §1910.421(d) — "Planning assessment", §1910.421(e) — "Hazardous activities", and §1910.422(a)(3) which requires providing a means to assist an injured diver from the water."

Commercial scuba-air diving requires a minimum of three (3) dive team members as follows:

**Designated person-in-charge (DPIC)** sometimes referred to as the **Diving Supervisor**, a **stand-by diver**, and a **line-tended diver**.

Commercial surface-supplied air diving requires a minimum of three dive team members as follows:

**DPIC (1)** and a **diver (2)** who shall be continuously tended (**by a tender [3]**) while in the water.

For surface-supplied air diving which is 100 feet or less, and where decompression is not required, a standby diver is not a specified requirement for all dives.

Tender personnel are members of the dive team and must meet the requirements set forth above. Tender personnel must at all times keep at least one hand on the divers' umbilical or line.

## 12.7 OPERATING PROCEDURES

### 12.7.1 Non-isolated Storage-Facility Operations

While the water facility operator may choose to isolate the facility from the system during underwater maintenance activities, it is however recognized that isolation of the storage facility in order to undertake routine underwater maintenance may be inconvenient, or even impossible, as a result of system operating or design limitation.

Any diving operation conducted with the water storage facility in a non-isolated status may present potential hazard to the diver. This is due to the differential pressure created by the head of water versus the decreased pressure at the valve outlet location.

Under such conditions a thorough evaluation of the situation must be considered during planning and assessment and proper steps taken to ensure that the diver and equipment will not be subjected to the differential pressure.

Steps must be taken to ensure that the diver is aware of the fact that a particular valve will be open and that a differential pressure hazard exists. Care must be taken to furnish the diver with a detailed location of open valves and to instruct the diver to remain clear of any such openings.

The water facility operator **MUST** take part in discussions relative to diver safety in a non-isolated facility and be prepared to take appropriate action as agreed!

## 12.8 ISOLATED STORAGE-FACILITY OPERATIONS

1. In the event that the water facility operator elects to isolate the water storage facility for the conduct of underwater maintenance activities, the facility shall be removed from service and isolated from the system prior to the commencement of any diving activity. All system primary and secondary inlet and outlet valves must be verified as locked and tagged "closed" by the designated person in charge (diving supervisor) of the diving operation.
2. In the event that storage facility valves must be inspected during diving operations, system valves farther upstream, or downstream, must be closed.
3. All valves critical to isolation of the water storage facility must be tagged in either the open or closed position as agreed during planning and assessment. Security of the valve(s)



position must be assured and no valve either opened or closed that has been tagged in an alternate position without the express permission both of the water facility designated person in charge and the designated person in charge (diving supervisor) of the diving operation.

4. Divers shall not enter the riser pipe in an elevated tank unless the tank has been isolated and tagged in accordance with OSHA Lock Out/Tag Out procedures.

## 12.9 EQUIPMENT AND PERSONNEL REQUIREMENTS

### 12.9.1 Equipment

All diving and other equipment used for underwater inspection of potable-water storage facilities shall wherever possible be dedicated for that purpose only. If not feasible, all equipment intended for use in a potable-water storage facility shall be certified as having been thoroughly disinfected prior to arrival at the job site, and shall again be disinfected at the potable-water site.

In the event non-dedicated equipment must be used in potable-water storage facilities, this equipment should be disinfected by first removing all visible debris, dirt, or other substances and then totally immersed in 200 PPM chlorine solution for a minimum of two minutes prior to use in potable water. Total immersion means that all outside surfaces of the equipment that will have contact with the potable water must be in continuous contact with the 200 PPM chlorine solution.

**Diver Air Supply.** Equipment to be used inside potable-water facilities shall not be of a self-contained breathing apparatus design [SCUBA], except for short duration inspection purposes where the diver will not stir up sediment or in emergency circumstances. If SCUBA equipment is to be utilized it must be totally disinfected prior to the conduct of operations as set forth herein.

Surface supplied-air equipment shall consist of a compressor capable of delivering a minimum of Grade D air containing a maximum of 25 PPM of total hydrocarbon content (as methane); a filtration system, a volume storage tank, and a suitable air manifold. As an option to a compressor driven system; air may be supplied from suitable air banks containing high pressure breathing air and equipped with a suitable pressure reducing regulator system to connect to the air filter/volume tank/air manifold system. Regardless of which system is intended for use, the dive contractor shall make available for inspection at the dive site, documentation (or copies thereof) of air test results performed in accordance with OSHA Regulation §1910.430(b)(4).

- **Diver Umbilical.** Diving umbilical hoses shall, as a minimum, consist of the divers' breathing hose, a communications cable, and a means of determining the divers depth. If a pneumofathometer hose is not incorporated into the diver umbilical a positive means of determining the divers depth shall be furnished and/or ensured at the dive location. The maximum structural depth of the water tank floor may be used as a point of reference.

Communication shall be of a "hard wire" configuration. Wireless communication devices are unacceptable because they lack reliability in confined spaces such as the potable water storage environment.

- **Diver Clothing.** Each diver shall wear a vulcanized rubber or other smooth surface material dry-suit in good condition, free from tears, scrapes, damaged areas, or other imperfections that may impair the integrity of the suit or serve as a site for bacteriological contamination. Further, the divers dress, including the diving helmet and suit, shall provide complete encapsulation and isolation of the diver's body from the potable water.

The divers hands should be encased in rubber (not neoprene) gloves that are sealed to the suit cuffs to prevent the intrusion of water and possible bacteriological contamination.

- **Diving Helmet.** The diver(s) shall wear a diving helmet [a hard helmet that totally surrounds the divers head in a dry environment] equipped with live voice communications, a neck dam that can be sealed to the suit, and fitted to accept a bailout system with shut-off valve. Further, the helmet shall, just as all of his equipment and clothing, be considered as a potential source of bacteriological contamination. The use of a diver band mask (any configuration of mask and breathing regulator that does not totally surround the divers head with a dry helmet) shall be specifically prohibited except in the case of an emergency.
- **Emergency Air Supply.** Each diver shall carry and attach to his helmet an emergency air supply such as a bailout bottle. The bottle shall be fully charged and connected to the helmet with an in-line shut-off valve.

### 12.9.2 Personnel Requirements

- Persons trained and certified for the conduct of recreational diving are not considered qualified to participate in commercial diving operations unless they have received additional formal classroom, on-the-job or other advanced training.
- Persons engaged in diving operations involving potable water storage facilities shall be specifically trained for the conduct of such operations. These personnel perform a specific, function in an environment critical to the health and well being of those who depend upon the purity of the water source. As such, divers to be utilized for the conduct of these operations shall be certified by the diving contractor as having received a course of instruction appropriate to their intended task.
- Certification cards issued by recreational organizations such as PADI, NAUI, YMCA, SSI, etc. are not acceptable as proof of competency for the conduct of commercial diving operations.
- Diplomas issued from a recognized commercial diver training school, military documents to show training at least the equivalent of 2nd Class U.S. Navy Diver, ADCI Commercial Diver Certification Cards or certification cards from recognized foreign source, and dive logs that contain evidence of long-term participation in commercial diving can be used to establish the credentials of commercial divers.
- Personnel to be employed for the conduct of diving operations in potable water storage facilities must have received prior training and have experience in the conduct of such operations. Recognition of these factors is critical to preserve the integrity of the industry.
- All Personnel on the dive team shall be free of communicable diseases and shall not, without a physicians consent to return to diving activity, have been under a physician's care within the seven-day period prior to entering the facility. No person who knowingly has an abnormal temperature or symptoms of illness shall work in a water-storage facility. The water utility operator has the right to request a physician's assurance (based on a examination within the 48-hour period immediately prior to the time the diver enters the water storage facility) that all inspection personnel are free of water-transferable communicable diseases.

## 12.10 SAFETY

1. The diving contractor and persons in his employ shall comply with all related local, state, and federal requirements. In the event of a conflict, federal regulations [29 CFR, OSHA Subpart T - Commercial Diving Regulations] shall apply.



2. The diving contractor shall furnish all necessary safety equipment suitable for the specific access opening depth of water, and other aspects of the water-storage facility to be inspected.
3. In the event that an elevated water storage facility is not equipped with an approved fall protection and prevention system, one that meets the requirements of appropriate authority shall be provided. This requirement is to ensure the safety of the diver and support team members during the conduct of actual diving operations.
4. Both the potable water storage owner and diving contractor shall be alerted to the potential requirement to erect an OSHA approved tripod or other device suitable for lifting an injured diver from the water in the event of an emergency. This contingency must be considered and appropriately identified as to the responsible party.
5. Divers shall be cautioned to avoid creating turbidity by stirring up the sediment contained in the potable water storage facility. Such action creates a probability that microorganisms will be released from the sediment layer into the potable water supply.
6. The means to contact a local emergency response team shall be available at the dive site and, if feasible, they should be notified in advance that diving operations are scheduled during a specific time frame.

## 12.11 RECORDS

**Safe Practices Manual.** OSHA Regulations require each employer to develop and maintain a safe practices manual which shall be made available at the dive location to each dive team member as well as the inspector (if any) appointed by the utility operator. Required contents of the manual shall, as a minimum, consist of [each diving mode engaged in]:

- Safety procedures and checklists for diving operations.
- Assignments and responsibilities of the dive team members.
- Emergency procedures and checklists.
- Emergency procedures for fire, equipment failure, adverse environmental conditions, and medical illness and injury.

**Divers Log Books.** Dive team members should possess and maintain a divers log that properly reflects their record of dives. As an alternative, some records may be maintain at a centralized company site with information then being transferred to the divers individual log in a periodic manner.

**Equipment Inspection and Maintenance Records.** Evidence must be on file and available for inspection that all equipment to be used for diving has been tested and maintained in accordance with federal regulations.

**Medical Examination.** The designated-person-in-charge (diving supervisor) is required to have in his possession at the job site evidence that all persons employed in the conduct of diving operations have a current divers' medical examination on file together with evidence of any other required certification such as First Aid and CPR Training, etc.

## 12.12 GENERAL REQUIREMENTS

- For all diving operations intended to take place in an elevated structure, a means of rescue of personnel from the top of the structure shall be provided. A safe and effective means of lowering injured personnel from the top of such tanks will be provided.
- For diving operations to be conducted in a confined space; the provisions of applicable OSHA Regulations shall apply. A means for rescue of diving personnel from the confined space must be furnished. Additional personnel must be furnished as member(s) of the dive team as required by OSHA Regulations.







## SECTION 13.0

# HIGH PRESSURE WATER BLASTING





## 13.0 HIGH PRESSURE WATER BLASTING

### 13.1 INTRODUCTION

High pressure water jets are employed in a variety of ways to accomplish cleaning and cutting tasks underwater. These units typically operate at pressures of 10,000 - 20,000 psig and higher.

**Water jets at any pressure can be dangerous and cause serious and sometimes disabling injuries.**

### 13.2 ACTION

The ADCI in its technical and advisory capacity to the commercial diving industry offers the following recommendations regarding the use of water blasting equipment:

#### 13.2.1 General

- Personnel assigned to Waterblasting operations, particularly diving personnel should be trained by qualified personnel and properly demonstrate their knowledge and ability to perform a task prior to being required to do so.
- Serious harm and injury may result from the misuse of water blasting equipment and from the use of improperly selected fittings, hoses, or attachments. All components of the system should be checked against the manufacturers instructions to ensure that they are compatible and of the correct thread size and pressure rating for the intended service.
- All dive Team members (divers, tenders, and supervisors) should be familiar with the equipment intended for use and with the hazards associated with their operation.
- Prior to operation, all equipment should be inspected for damage and deterioration with particular attention paid to high-pressure hoses, fittings and gun trigger function.
- Prior to use in diving operations the Water Blasting equipment should be fully assembled and functionally tested, including Emergency Shutdown or Dump Valve operation.

### 13.3 PRIOR TO COMMENCEMENT OF UNDERWATER BLASTING OPERATIONS:

A survey of the underwater site should be undertaken to identify potential hazards. A Job Hazard Analysis should be done or reviewed by the Dive Team.

The Job Hazard Analysis should include, but not be limited to the following provisions:

- Tending of the divers umbilical and the high-pressure water hose during Waterblasting operations.
- System to be pressurized **only** on request from the diver.
- Ability to shutdown pressure to the gun quickly should the stand-by diver be needed.
- System pressure is shutdown prior to the diver leaving the worksite.
- Only one (1) diver is allowed in the water during water blasting operations except where: operations are conducted using penetration or confined space procedures where an outside tender is required Instructions that the water blaster nozzle shall never be lowered to the diver in a pressurized state.
- Due to the high noise levels generated, commands and signals should be agreed and reviewed between the diver and topside.



- Ear protection for the diver is necessary or limit diver exposure time due to the noise hazard.
- Trigger mechanism shall be of a dead-man type and **shall not** be tied back in the “**open**” position.
- Careful check of the retro jet nozzle guard as this could present a hazard to the diver and his hose if not properly guarded and diffused.
- Nozzle selection should be appropriate for the work intended (the smaller angle of rifle barrel nozzle being the most dangerous due to its cutting ability).

## **SECTION 14.0**

# **DEPARTMENT OF TRANSPORTATION**

**U.S. Coast Guard**

**COMMERCIAL DIVING OPERATIONS**

**General Provisions**



**Association of Diving Contractors International**





§ 197.20046

CFR Ch. 1 (10-1-89 Edition)

## SUBCHAPTER V-MARINE OCCUPATIONAL SAFETY AND HEALTH STANDARDS

### PART 197-GENERAL PROVISIONS

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#### Subpart B-Commercial Diving Operations

##### GENERAL

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##### EQUIPMENT

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- 197.450 Breathing gas tests.
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### RECORDS

- 197.480 Logbooks.
- 197.482 Logbook entries.
- 197.484 Notice of casualty.
- 197.486 Written report of casualty.
- 197.488 Retention of records after casualty.

#### Appendix A-Air No-Decompression Limits

Authority: 33 U.S.C. 1509; 43 U.S.C. 1333; 46 U.S.C. 3306, 3703, 6101; 49 CFR 1.46.

Source: CGD 76-009, 43 FR 53683, Nov. 16, 1978, unless otherwise noted.



## Subpart A - [Reserved]

## Subpart B - Commercial Diving Operations GENERAL

### § 197.200 Purpose of subpart.

This subpart prescribes rules for the design, construction, and use of equipment, and inspection, operation, and safety and health standards for commercial diving operations taking place from vessels and facilities under Coast Guard jurisdiction.

### § 197.202 Applicability.

(a) This subpart applies to commercial diving operations taking place at any deepwater port or the safety zone the of as defined in 33 CFR 150; from any artificial island, installation, or other device on the Outer Continental Shelf and the waters adjacent thereto as defined in 33 CFR 147 or otherwise related to activities on the Outer Continental Shelf; and from all vessels required to have a certificate of inspection issued by the Coast Guard including mobile offshore drilling units regardless of their geographic location, or from any vessel connected with a deepwater port or within the deepwater port safety zone, or from any vessel engaged in activities related to the Outer Continental Shelf; except that this subpart does not apply to any diving operation-

- (1) Performed solely for marine scientific research and development purposes by educational institutions;
- (2) Performed solely for research and development for the advancement of diving equipment and technology; or
- (3) Performed solely for search and rescue or related public safety purposes by or under the control of a governmental agency.

(b) Diving operations may deviate from the requirements of this subpart to the extent necessary to prevent or minimize a situation which is likely to cause death, injury, or major environmental damage. The circumstances leading to the situation, the deviations made, and the corrective action taken, if appropriate, to reduce the possibility of

recurrence shall be recorded by the diving supervisor in the logbook as required by § 197.482(c).

### § 197.204 Definitions.

As used in this subpart:

- *ACFM* means actual cubic feet per minute.
- *ANSI Code1* means the B31.1 American National Standards Institute "Code for Pressure Piping, Power Piping."
- *ASME Code* means the American Society of Mechanical Engineers "Boiler and Pressure Vessel Code."
- *ASME PVHO-1* means the ANSI/ASME standard "Safety Standard for Pressure Vessels for Human Occupancy."
- *ATA* means a measure of pressure expressed in terms of atmosphere absolute (includes barometric pressure).
- *Bell* means a compartment either at ambient pressure (open bell) or pressurized (closed bell) that allows the diver to be transported to and from the underwater work site, allows the diver access to the surrounding environment, and is capable of being used as a refuge during diving operations.
- *Bottom time* means the total elapsed time measured in minutes from the time the diver leaves the surface in descent to the time to the next whole minute that the diver begins ascent.
- *Breathing gas/breathing mixture* means the mixed-gas, oxygen, or air as appropriate supplied to the diver for breathing.
- *Bursting pressure* means the pressure at which a pressure containment device would fail structurally.
- *Commercial diver* means a diver engaged in underwater work for hire excluding sport and recreational diving and the instruction thereof.
- *Commercial diving operation* means all activities in support of a commercial diver.
- *Cylinder* means a pressure vessel for the storage of gases under pressure.
- *Decompression chamber* means a pressure vessel for human occupancy such as a surface decompression chamber, closed bell, or deep diving system especially equipped to recompress, decompress, and treat divers.



- *Decompression sickness* means a condition caused by the formation of gas or gas bubbles in the blood or body tissue as a result of pressure reduction.
- *Decompression table* means a profile or set of profiles of ascent rates and breathing mixtures designed to reduce the pressure on a diver safely to atmospheric pressure after the diver has been exposed to a specific depth and bottom time.
- *Depth* means the maximum pressure expressed in feet of seawater attained by a diver and is used to express the depth of a dive.
- *Dive location* means that portion of a vessel or facility from which a diving operation is conducted.
- *Dive team* means the divers and diver support personnel involved in a diving operation, including the diving supervisor.
- *Diver* means a person working beneath the surface, exposed to hyperbaric conditions, and using underwater breathing apparatus.
- *Diver-carried reserve breathing gas* means a supply of air or mixed-gas, as appropriate, carried by the diver in addition to the primary or secondary breathing gas supplied to the diver.
- *Diving installation* means all of the equipment used in support of a commercial diving operation.
- *Diving mode* means a type of diving requiring SCUBA, surface-supplied air, or surface-supplied mixed-gas equipment, with related procedures and techniques.
- *Diving stage* means a suspended platform constructed to carry one or more divers and used for putting divers into the water and bringing them to the surface when in-water decompression or a heavy weight diving outfit is used.
- *Diving supervisor* means the person having complete responsibility for the safety of a commercial diving operation including the responsibility for the safety and health of all diving personnel in accordance with this subpart.
- *Facility* means a deepwater port, or an artificial island, installation, or other device on the Outer Continental Shelf subject to Coast Guard jurisdiction.
- *Fsw* means feet of seawater (or equivalent static pressure head).
- *Gas embolism* means a condition caused by expanding gases, which have been taken into and retained in the lungs while breathing under pressure, being forced into the bloodstream or other tissues during ascent or decompression.
- *Heavy-weight diving outfit* means diver-worn surface-supplied deep-sea dress.
- *Hyperbaric conditions* means pressure conditions in excess of surface atmospheric pressure.
- *Injurious corrosion* means an advanced state of corrosion which may impair the structural integrity or safe operation of the equipment.
- *Liveboating* means the support of a surfaced-supplied diver from a vessel underway.
- *Maximum working pressure* means the maximum pressure to which a pressure containment device can be exposed under operating conditions (usually the pressure setting of the pressure relief device).
- *No-decompression limits* means the air depth and bottom time limits of appendix A.
- *Pressure vessel* means a container capable of withstanding an internal maximum working pressure over 15 psig.
- *Psi(g)* means pounds per square inch (gauge).
- *PVHO* means pressure vessel for human occupancy but does not include pressure vessels for human occupancy that may be subjected to external pressures in excess of 15 psig but can only be subjected to maximum internal pressures of 15 psig or less (i.e., submersibles, or one atmosphere observation bells).
- *Saturation diving* means saturating a diver's tissues with the inert gas in the breathing mixture to allow an extension of bottom time without additional decompression.
- *SCUBA diving* means a diving mode in which the diver is supplied with a compressed breathing mixture from diver carried equipment.
- *Standby diver* means a diver at the dive location available to assist a diver in the water.



- *Surface-supplied air diving* means a diving mode in which the diver is supplied from the dive location or bell with compressed breathing air including oxygen or oxygen enriched air if supplied for treatment.
- *Surface-supplied mixed-gas diving* means a diving mode in which the diver is supplied from the dive location or bell with a compressed breathing mixture other than air.
- *Timekeeping device* means a device for measuring the time of a dive in minutes.
- *Treatment table* means a depth, time, and breathing gas profile designed to treat a diver for decompression sickness.
- *Umbilical* means the hose bundle between a dive location and a diver or bell, or between a diver and a bell, that supplies the diver or bell with a life-line, breathing gas, communications, power, and heat as appropriate to the diving mode or conditions.
- *Vessel* means any waterborne craft including mobile offshore drilling units required to have a Certificate of Inspection issued by the Coast Guard or any waterborne craft connected with a deepwater port or within the deepwater port safety zone, or any waterborne craft engaged in activities related to the Outer Continental Shelf.
- *Volume tank* means a pressure vessel connected to the outlet of a compressor and used as an air reservoir.
- *Working pressure* means the pressure to which a pressure containment device is exposed at any particular instant during normal operating conditions.

#### § 197.205 Availability of standards.

- (a) Several standards have been incorporated by reference in this subchapter. The incorporation by reference has been approved by the Director of the Federal Register under the provisions of 1 CFR Part 51.
- (b) The standards are available from the appropriate organizations whose addresses are listed below:

- (1) American National Standards Institute, 1430 Broadway  
New York, NY 10018.

- (2) American Society of Mechanical Engineers  
United Engineering Center  
345 East 47th Street  
New York, NY 10017.

#### § 197.206 Substitutes for required equipment, materials, apparatus, arrangements, procedures, or tests.

- (a) The Coast Guard may accept substitutes for equipment, materials, apparatus, arrangements, procedures, or tests required in this subpart if the substitute provides an equivalent level of safety.
- (b) In any case where it is shown to the satisfaction of the Commandant that the use of any particular equipment, material, apparatus, arrangement, procedure, or test is unreasonable or impracticable, the Commandant may permit the use of alternate equipment, material, apparatus, arrangement, procedure, or test to such an extent and upon such condition as will insure, to his satisfaction, a degree of safety consistent with the minimum standards set forth in this subpart.

#### § 197.208 Designation of person-in-charge.

- (a) The owner or agent of a vessel or facility without a designated master shall designate, in writing, an individual to be the person-in-charge of the vessel or facility.
- (b) Where a master is designated, the master is the person-in-charge.

#### § 197.210 Designation of diving supervisor.

The name of the diving supervisor for each commercial diving operation shall be—

- (a) Designated in writing; and
- (b) Given to the person-in-charge prior to the commencement of any commercial diving operation.

## EQUIPMENT

### § 197.300 Applicability.

- (a) Each diving installation used on each vessel or facility subject to this subpart must meet the requirements of this subpart.
- (b) In addition to the requirements of this subpart, equipment which is permanently installed on vessels and is part of the diving installation must meet Subchapters F and J of this chapter.
- (c) All repairs and modifications to pressure vessels used for commercial diving operations must be made in accordance with the requirements of section VIII, division 1 or division 2 of the ASME Code, ASME PVHO-1, part 54 of this chapter, or 49 CFR 173.34, as applicable.
- (d) All repairs and modifications to pressure piping used for commercial diving operations must be made in accordance with the requirements of the ANSI Code or Part 56 of this chapter, as applicable.

### § 197.310 Air compressor system.

A compressor used to supply breathing air to a diver must have-

- (a) A volume tank that is-
  - (1) Built and stamped in accordance with section VIII, division 1 of the ASME Code with-
    - (i) A check valve on the inlet side;
    - (ii) A pressure gage;
    - (iii) A relief valve; and
    - (iv) A drain valve; and
  - (2) Tested after every repair, modification, or alteration to the pressure boundaries as required by § 197.462;
- (b) Intakes that are located away from areas containing exhaust fumes of internal combustion engines or other hazardous contaminants;
- (c) An efficient filtration system; and
- (d) Slow-opening shut-off valves when the maximum allowable working pressure of the system exceeds 500 psig.

### § 197.312 Breathing supply hoses.

- (a) Each breathing supply hose must-
  - (1) Have a maximum working pressure that is equal to or exceeds-
    - (i) The maximum working pressure of the section of the breathing supply system in which used; and
    - (ii) The pressure equivalent of the maximum depth of the dive relative to the supply source plus 100 psig;
  - (2) Have a bursting pressure of four times its maximum working pressure;
  - (3) Have connectors that-
    - (i) Are made of corrosion-resistant material;
    - (ii) Are resistant to accidental disengagement; and
    - (iii) Have a maximum working pressure that is at least equal to the maximum working pressure of the hose to which they are attached; and
  - (4) Resist kinking by-
    - (i) Being made of kink-resistant materials; or
    - (ii) Having exterior support.
- (b) Each umbilical must-
  - (1) Meet the requirements of paragraph (a) of this section; and
  - (2) Be marked from the diver or open bell end in 10-foot intervals to 100 feet and in 50-foot intervals thereafter.

### § 197.314 First aid and treatment equipment.

- (a) Each dive location must have-
  - (1) A medical kit approved by a physician that consists of-
    - (i) Basic first aid supplies; and
    - (ii) Any additional supplies necessary to treat minor trauma and illnesses resulting from hyperbaric exposure;
  - (2) A copy of an American Red Cross Standard First Aid handbook;
  - (3) A bag-type manual resuscitator with transparent mask and tubing; and
  - (4) A capability to remove an injured diver from the water.



- (b) Each diving installation must have a two-way communications system to obtain emergency assistance except when the vessel or facility ship-to-shore, two-way communications system is readily available.
- (c) Each dive location supporting mixed-gas dives, dives deeper than 130 fsw, or dives outside the no-decompression limits must meet the requirements of paragraph (a) of this section and have-
  - (1) A decompression chamber;
  - (2) Decompression and treatment tables;
  - (3) A supply of breathing gases sufficient to treat for decompression sickness;
  - (4) The medical kit required by paragraph (a)(1) of this section that is-
    - (i) Capable of being carried into the decompression chamber; and
    - (ii) Suitable for use under hyperbaric conditions; and
  - (5) A capability to assist an injured diver into the decompression chamber.

#### **§ 197.318 Gages and timekeeping devices.**

- (a) A gage indicating diver depth must be at each dive location for surface-supplied dives.
- (b) A timekeeping device must be at each dive location.

#### **§ 197.320 Diving ladder and stage.**

- (a) Each diving ladder must-
  - (1) Be capable of supporting the weight of at least two divers;
  - (2) Extend 3 feet below the water surface;
  - (3) Be firmly in place;
  - (4) Be available at the dive location for a diver to enter or exit the water unless a diving stage or bell is provided; and
- (5) Be-
  - (i) Made of corrosion-resistant material;
  - (ii) Protected against and maintained free from injurious corrosion.
- (b) Each diving stage must-
  - (1) Be capable of supporting the weight of at least two divers;
  - (2) Have an open-grating platform;

- (3) Be available for a diver to enter or exit the water from the dive location and for in-water decompression if the diver is-
  - (i) Wearing a heavy-weight diving outfit; or
  - (ii) Diving outside the no-decompression limits, except when a bell is provided; and
- (4) Be-
  - (i) Made of corrosion-resistant material; or
  - (ii) Protected against and maintained free from injurious corrosion.

#### **§ 197.322 Surface-supplied helmets and masks.**

- (a) Each surface-supplied helmet or mask must have-
  - (1) A nonreturn valve at the attachment point between helmet or mask and umbilical that closes readily and positively;
  - (2) An exhaust valve; and
  - (3) A two-way voice communication system between the diver and the dive location or bell.
- (b) Each surface-supplied air helmet or mask must-
  - (1) Ventilate at least 4.5 ACFM at any depth at which it is operated; or
  - (2) Be able to maintain the diver's inspired carbon dioxide partial pressure below 0.02 ATA when the diver is producing carbon dioxide at the rate of 1.6 standard liters per minute.

#### **§ 197.324 Diver's safety harness.**

Each safety harness used in surface-supplied diving must have-

- (a) A positive buckling device; and
- (b) An attachment point for the umbilical life line that-
  - (1) Distributes the pulling force of the umbilical over the diver's body; and
  - (2) Prevents strain on the mask or helmet.

### § 197.326 Oxygen safety.

- (a) Equipment used with oxygen or oxygen mixtures greater than 40 percent by volume must be designed for such use.
- (b) Oxygen systems with pressures greater than 125 psig must have slow-opening shut-off valves except pressure boundary shut-off valves may be ball valves.

### § 197.328 PVHO-General.

- (a) Each PVHO, contracted for or purchased after February 1, 1979, must be built and stamped in accordance with ASME PVHO-1.
- (b) Each PVHO, contracted for or constructed before February 1, 1979, and not Coast Guard approved, must be submitted to the Coast Guard for approval prior to February 1, 1984.
- (c) To be approved under paragraph (b), a PVHO must be-
  - (1) Constructed in accordance with Part 54 of this chapter; or
  - (2) Be built in accordance with section VIII, division 1 or division 2 of the ASME Code; and-
    - (i) Have the plans approved in accordance with § 54.01-18 of this chapter;
    - (ii) Pass the radiographic and other survey tests of welded joints required by section VIII, division 1 or division 2, as appropriate, of the ASME Code; and
    - (iii) Pass-(A) The hydrostatic test described in § 54.10-10 of this chapter; or
      - (B) The pneumatic test described in § 54.10-15 of this chapter and such additional tests as the Officer-in-Charge Marine Inspection (OCMI) may require.
- (d) Each PVHO must-
  - (1) Have a shut-off valve located within 1 foot of the pressure boundary on all piping penetrating the pressure boundary;
  - (2) Have a check valve located within 1 foot of the pressure boundary on all piping exclusively carrying fluids into

- the PVHO;
- (3) Have the pressure relief device required by ASME PVHO-1;
- (4) Have a built-in breathing system with at least one mask per occupant stored inside each separately pressurized compartment;
- (5) Have a two-way voice communications system allowing communications between an occupant in one pressurized compartment of the PVHO and-
  - (i) The diving supervisor at the dive location;
  - (ii) Any divers being supported from the same PVHO; and
  - (iii) Occupants of other separately pressurized compartments of the same PVHO;
- (6) If designed to mechanically couple to another PVHO, have a two-way communications system allowing communications between occupants of each PVHO when mechanically coupled;
- (7) Have a pressure gage in the interior of each compartment that is-
  - (i) Designed for human occupancy; and
  - (ii) Capable of having the compartment pressure controlled from inside the PVHO;
- (8) Have viewports that allow observation of occupants from the outside;
- (9) Have viewports that meet the requirements of ASME PVHO-1 except those PVHO's approved under paragraph (b) of this section which have nonacrylic viewports;
- (10) Have means of illumination sufficient to allow an occupant to-
  - (i) Read gages; and
  - (ii) Operate the installed systems within each compartment;
- (11) Be designed and equipped to minimize sources of combustible materials and ignition;
- (12) Have a protective device on the inlet side of PVHO exhaust lines;
- (13) Have a means of extinguishing a fire in the interior;
- (14) Have a means of maintaining the oxygen content of the interior atmosphere below 25 percent surface equivalent by volume when pressur-





- ized with air as the breathing mixture;
- (15) Have a means of maintaining the interior atmosphere below 2 percent surface equivalent carbon dioxide by volume;
  - (16) Have a means of overriding and controlling from the exterior all interior breathing and pressure supply controls;
  - (17) Have a speech unscrambler when used with mixed-gas;
  - (18) Have interior electrical systems that are designed for the environment in which they will operate to minimize the risk of fire, electrical shock to personnel, and galvanic action of the PVHO; and
  - (19) Be tested after every repair, modification, or alteration to the pressure boundaries as required by § 197.462.

### § 197.330 PVHO-Closed bells.

- (a) Except as provided in paragraph (b) of this section, each closed bell must meet the requirements of § 197.328 and-
  - (1) Have underwater breathing apparatus for each occupant stored inside each separately pressurized compartment;
  - (2) Have an umbilical;
  - (3) Have lifting equipment attached to the closed bell capable of returning the occupied closed bell when fully flooded to the dive location;
  - (4) Be capable of recompressing on the surface to the maximum design diving depth;
  - (5) Be constructed and equipped as required by § 197.332;
  - (6) Have an emergency locating device designed to assist personnel on the surface in acquiring and maintaining contact with the submerged PVHO if the umbilical to the surface is severed;
  - (7) Have a capability to remove an injured diver from the water; and
  - (8) Have a life support capability for the intact closed bell and its occupants

for-

- (i) Twelve hours after an accident severing the umbilical to the surface when the umbilical to the surface is the only installed means of retrieving the closed bell; or
  - (ii) A period of time, at least equal to 1 hour plus twice the time required to retrieve the bell from its designed operating depth and attach an auxiliary lifesupport system, after an accident severing the umbilical to the surface when the umbilical is one of the two independent installed means of retrieving the closed bell, each meeting the requirements of paragraph (a)(3) of this section.
- (b) A closed bell that does not meet the requirements of paragraphs (a)(3), (a)(4), and (a)(5) of this section, must be capable of attachment to another PVHO that-
    - (1) Allows the transfer of personnel and diver's equipment under pressure from the closed bell to the PVHO;
    - (2) Meets the requirements of paragraph (a)(3) of this section;
    - (3) Is capable of attachment to a decompression chamber meeting the requirements of paragraphs (a)(4) and (a)(5) of this section; and
    - (4) Allows the transfer of personnel and diver's equipment under pressure from the PVHO to the decompression chamber.

### § 197.332 PVHO-Decompression chambers.

Each decompression chamber must-

- (a) Meet the requirements of § 197.328;
- (b) Have internal dimensions sufficient to accommodate a diver lying in a horizontal position and another person tending the diver;
- (c) Have a capability for ingress and egress of personnel and equipment while the occupants are under pressure;
- (d) Have a means of operating all installed man-way locking devices, except disabled shipping dogs, from both sides of a closed hatch;
- (e) Have interior illumination sufficient to allow visual observation, diagnosis, and medical treatment of an occupant.
- (f) Have one bunk for each two occupants;



- (g) Have a capability that allows bunks to be seen over their entire lengths from the exterior;
- (h) Have a minimum pressure capability of:
  - (1) 6 ATA, when used for diving to 300 fsw; or
  - (2) The maximum depth of the dive, when used for diving operations deeper than 300 fsw, unless a closed bell meeting the requirements of § 197.330(a) (3), (4), and (5) is used;
    - (i) Have a minimum pressurization rate of 2 ATA per minute to 60 fsw and at least 1 ATA per minute thereafter;
- (j) Have a decompression rate of 1 ATA per minute to 33 fsw;
- (k) Have an external pressure gage for each pressurized compartment;
- (l) Have a capability to supply breathing mixtures at the maximum rate required by each occupant doing heavy work; and
- (m) Have a sound-powered headset or telephone as a backup to the communications system required by

§ 197.328(c) (5) and (6), except when that communications system is a sound-powered system.

### § 197.334 Open diving bells.

Each open diving bell must-

- (a) Have an upper section that provides an envelope capable of maintaining a bubble of breathing mixture available to a diver standing on the lower section of the platform with his body through the open bottom and his head in the bubble;
- (b) Have lifting equipment capable of returning the occupied open bell to the dive location;
- (c) Have an umbilical; and
- (d) Be-
  - (1) Made of corrosion-resisting material; or
  - (2) Protected against and maintained free from injurious corrosion.

### § 197.336 Pressure piping.

Piping systems that are not an integral part of the vessel or facility, carrying fluids under pres-

sure exceeding 15 psig must-

- (a) Meet the ANSI Code;
- (b) Have the point of connection to the integral piping system of the vessel or facility clearly marked; and
- (c) Be tested after every repair, modification, or alteration to the pressure boundaries as set forth in § 197.462.

### § 197.338 Compressed gas cylinders.

Each compressed gas cylinder must-

- (a) Be stored in a ventilated area;
- (b) Be protected from excessive heat;
- (c) Be prevented from falling;
- (d) Be tested after any repair, modification, or alteration to the pressure boundaries as set forth in § 197.462; and
- (e) Meet the requirements of-
  - (1) Part 54 of this Chapter; or
  - (2) 49 CFR 173.34 and 49 CFR 178 Subpart C.

### § 197.340 Breathing gas supply.

- (a) A primary breathing gas supply for surface-supplied diving must be sufficient to support the following for the duration of the planned dive:
  - (1) The diver.
  - (2) The standby diver.
  - (3) The decompression chamber, when required by § 197.432(e)(2) or by § 197.434(a) for the duration of the dive and for one hour after completion of the planned dive.
  - (4) A decompression chamber when provided but not required by this subpart.
  - (5) A closed bell when provided or required by § 197.434(d).
  - (6) An open bell when provided or required by § 197.432(e)(4) or by § 197.434(c).
- (b) A secondary breathing gas supply for surface-supplied diving must be sufficient to support the following:
  - (1) The diver while returning to the surface.



- (2) The diver during decompression.
- (3) The standby diver.
- (4) The decompression chamber when required by § 197.432(e)(2) or by § 197.434(a) for the duration of the dive and one hour after the completion of the planned dive.
- (5) The closed bell while returning the diver to the surface.
- (6) The open bell while returning the diver to the surface.
- (c) A diver-carried reserve breathing gas supply for surface-supplied diving must be sufficient to allow the diver to-
  - (1) Reach the surface.
  - (2) Reach another source of breathing gas; or
  - (3) Be reached by a standby diver equipped with another source of breathing gas for the diver.
- (d) A primary breathing gas supply for SCUBA diving must be sufficient to support the diver for the duration of the planned dive through his return to the dive location or planned pick-up point.
- (e) A diver-carried reserve breathing gas supply for SCUBA diving must be sufficient to allow the diver to return to the dive location or planned pickup point from the greatest depth of the planned dive.
- (f) Oxygen used for breathing mixtures must-
  - (1) Meet the requirements of Federal Specification BB-0-925a; and
  - (2) Be type 1 (gaseous) grade A or B.
- (g) Nitrogen used for breathing mixtures must-
  - (1) Meet the requirements of Federal Specification BB-N-411c;
  - (2) Be type 1 (gaseous);
  - (3) Be class 1 (oil free); and
  - (4) Be grade A, B, or C.
- (h) Helium used for breathing mixtures must be grades A, B, or C produced by the Federal Government, or equivalent.
- (i) Compressed air used for breathing mixtures must-
  - (1) Be 20 to 22 percent oxygen by volume;
  - (2) Have no objectionable odor; and
  - (3) Have no more than-
    - (i) 1,000 parts per million of carbon dioxide;
    - (ii) 20 parts per million of carbon

monoxide;

- (iii) 5 milligrams per cubic meter of solid and liquid particulates including oil; and
- (iv) 25 parts per million of hydrocarbons (includes methane and all other hydrocarbons expressed as methane).

#### **§ 197.342 Buoyancy-changing devices.**

- (a) A dry suit or other buoyancy-changing device not directly connected to the exhaust valve of the helmet or mask must have an independent exhaust valve.
- (b) When used for SCUBA diving, a buoyancy-changing device must have an inflation source separate from the breathing gas supply.

#### **§ 197.344 Inflatable floatation devices.**

An inflatable flotation device for SCUBA diving must-

- (a) Be capable of maintaining the diver at the surface in a faceup position;
- (b) Have a manually activated inflation device;
- (d) Have an oral inflation device; and
- (e) Have a manually operated exhaust valve.

#### **§ 197.346 Diver's equipment.**

- (a) Each diver using SCUBA must have-
  - (1) Self-contained underwater breathing equipment including-
    - (i) A primary breathing gas supply with a cylinder pressure gage readable by the diver during the dive; and
    - (ii) A diver-carried reserve breathing gas supply provided by-
      - (A) A manual reserve (J valve); or
      - (B) An independent reserve cylinder connected and ready for use;
  - (2) A face mask;
  - (3) An inflatable floatation device;
  - (4) A weight belt capable of quick release;
  - (5) A knife;
  - (6) Swim fins or shoes;





- (7) A diving wristwatch; and
  - (8) A depth gage.
- (b) Each diver using a heavyweight diving outfit must-
  - (1) Have a helmet group consisting of helmet, breastplate, and associated valves and connections;
  - (2) Have a diving dress group consisting of a basic dress that encloses the body (except for head and hands) in a tough, waterproof cover, gloves, shoes, weight assembly, and knife;
  - (3) Have a hose group consisting of the breathing gas hose and fittings, the control valve, the lifeline, communications cable, and a pneumofathometer; and
  - (4) Be provided with a helmet cushion and weighted shoes.
- (c) Each surface-supplied dive operation using a heavyweight diving outfit must have an extra breathing gas hose with attaching tools available to the standby diver.
- (d) Each diver using a lightweight diving outfit must have-
  - (1) A safety harness;
  - (2) A weight assembly capable of quick release;
  - (3) A mask group consisting of a lightweight mask and associated valves and connections;
  - (4) A diving dress group consisting of wet or dry diving dress, gloves, shoes or fins, and knife; and
  - (5) A hose group consisting of the breathing gas hose and fittings, the control valve, the lifeline, communications cable, and a pneumofathometer (if the breaking strength of the communications cable is at least equal to that required for the lifeline, the communications cable can serve as the lifeline).
- (e) Each surface-supplied air dive operation within the no-decompression limits and to depths of 130 fsw or less must have a primary breathing gas supply at the dive location.
- (f) Each surface-supplied dive operation outside the no-compression limits, deeper than 130 fsw, or using mixed-gas as a breathing mixture must have at the dive location-

- (1) A primary breathing gas supply; and
  - (2) A secondary breathing gas supply.
- (g) Each diver diving outside the no-decompression limits, deeper than 130 fsw, or using mixed-gas must have a diver-carried reserve breathing gas supply except when using a heavy-weight diving outfit or when diving in a physically confining area.

## OPERATIONS

### § 197.400 Applicability.

Diving operations may only be conducted from a vessel or facility subject to the subpart if the regulations in this subpart are met.

### § 197.402 Responsibilities of the person-in-charge.

- (a) The person-in-charge shall-
  - (1) Be fully cognizant of the provisions of this subpart;
  - (2) Prior to permitting any commercial diving operation to commence, have-
    - (i) The designation of the diving supervisor for each diving operation as required by § 197.210;
    - (ii) A report on-
      - (A) The nature and planned times of the planned diving operation; and
      - (B) The planned involvement of the vessel or facility, its equipment, and its personnel in the diving operation.
- (b) Prior to permitting any commercial diving operation involving liveboating to commence, the person-in-charge shall insure that-
  - (1) A means of rapid communications with the diving supervisor while the diver is entering, in, or leaving the water is established; and
  - (2) A boat and crew for diver pickup in the event of an emergency is provided.
- (c) The person-in-charge shall insure that a boat and crew for SCUBA diver pickup is provided when SCUBA divers are not line-tended from the dive location.
- (d) The person-in-charge shall coordinate the activities on and of the vessel or facility with the diving supervisor.



- (e) The person-in-charge shall insure that the vessel or facility equipment and personnel are kept clear of the dive location except after coordinating with the diving supervisor.

#### **§ 197.404 Responsibilities of the diving supervisor.**

- (a) The diving supervisor shall-
- (1) Be fully cognizant of the provisions of this subpart;
  - (2) Be fully cognizant of the provisions of the operations manual required by § 197.420;
  - (3) Insure that diving operations conducted from a vessel or facility subject to this subpart meet the regulations in this subpart;
  - (4) Prior to the commencement of any commercial diving operation, provide the report required by § 197.402 to the person-in-charge;
  - (5) Coordinate with the person-in-charge any changes that are made to the report required by § 197.402; and
  - (6) Promptly notify the person-in-charge of any diving related casualty, accident, or injury.
- (b) the diving supervisor is in charge of the planning and execution of the diving operation including the responsibility for the safety and health of the dive team.

#### **§ 197.410 Dive procedures.**

- (a) The diving supervisor shall insure that-
- (1) Before commencing diving operations, dive team members are briefed on-
    - (i) The tasks to be undertaken;
    - (ii) Any unusual hazards or environmental conditions likely to affect the safety of the diving operation; and
    - (iii) Any modifications to the operations manual or procedures including safety procedures necessitated by the specific diving operation;
  - (2) The breathing gas supply systems, masks, helmets, thermal protection, when provided, and bell lifting equip-

ment, when a bell is provided or required, are inspected prior to each diving operation;

- (3) Each diver is instructed to report any physical problems or physiological effects including aches, pains, current illnesses, or symptoms of decompression sickness prior to each dive;
- (4) A depth, bottom time profile, including any breathing mixture changes, is maintained at the dive location for each diver during the dive, except that SCUBA divers shall maintain their own profiles;
- (5) A two-way voice communication system is used between-
  - (i) Each surface-supplied diver and a dive team member at the dive location or bell (when provided); and
  - (ii) The bell (when provided) and the dive location;
- (6) A two-way communication system is available at the dive location to obtain emergency assistance;
- (7) After the completion of each dive-
  - (i) The physical condition of the diver is checked by-
    - (A) Visual observation; and
    - (B) Questioning the diver about his physical well-being;
  - (ii) The diver is instructed to report any physical problems or adverse physiological effects including aches, pains, current illnesses, or symptoms of decompression sickness or gas embolism;
  - (iii) The diver is advised of the location of an operational decompression chamber; and
  - (iv) The diver is alerted to the potential hazards of flying after diving;
- (8) For any dive outside the no-decompression limits, deeper than 130 fsw, or using mixed-gas as a breathing mixture-
  - (i) A depth, time, decompression profile including breathing mixture changes is maintained for each diver at the dive location;

- (ii) The diver is instructed to remain awake and in the vicinity of the dive location decompression chamber for at least one hour after the completion of a dive, decompression, or treatment; and
  - (iii) A dive team member, other than the diver, is trained and available to operate the decompression chamber; and
- (9) When decompression sickness or gas embolism is suspected or symptoms are evident, a report is completed containing-
  - (i) The investigation for each incident including-
    - (A) The dive and decompression profiles;
    - (B) The composition, depth, and time of breathing mixture changes;
    - (C) A description of the symptoms including depth and time of onset; and
    - (D) A description and results of the treatment;
  - (ii) The evaluation for each incident based on-
    - (A) The investigation;
    - (B) Consideration of the past performance of the decompression table used; and
    - (C) Individual susceptibility; and
  - (iii) The corrective action taken, if necessary, to reduce the probability of recurrence.
- (b) The diving supervisor shall ensure that the working interval of a dive is terminated when he so directs or when-
  - (1) A diver requests termination;
  - (2) A diver fails to respond correctly to communications or signals from a dive team member;
  - (3) Communications are lost and cannot be quickly reestablished between-
    - (i) The diver and a dive team member at the dive location; or
    - (ii) The person-in-charge and the diving supervisor during live-boating operations; or
  - (4) A diver begins to use his diver-carried reserve breathing gas supply.

## § 197.420 Operations manual.

- (a) The diving supervisor shall-
  - (1) Provide an operations manual to the person-in-charge prior to commencement of any diving operation; and
  - (2) Make an operations manual available at the dive location to all members of the dive team.
- (b) The operations manual must be modified in writing when adaptation is required because of-
  - (1) The configuration or operation of the vessel or facility; or
  - (2) The specific diving operation as planned.
- (c) The operations manual must provide for the safety and health of the divers.
- (d) The operations manual must contain the following:
  - (1) Safety procedures and checklists for each diving mode used.
  - (2) Assignments and responsibilities of each dive team member for each diving mode used.
  - (3) Equipment procedures and checklists for each diving mode used.
  - (4) Emergency procedures for-
    - (i) Fire;
    - (ii) Equipment failure;
    - (iii) Adverse environmental conditions including, but not limited to, weather and sea state;
    - (iv) Medical illness; and
    - (v) Treatment of injury.
  - (5) Procedures dealing with the use of-
    - (i) Hand-held power tools;
    - (ii) Welding and burning equipment; and
    - (iii) Explosives.

## SPECIFIC DIVING MODE PROCEDURES

### § 197.430 SCUBA diving.

The diving supervisor shall insure that-

- (a) SCUBA diving is not conducted-
  - (1) Outside the no-decompression limits;
  - (2) At depths greater than 130 fsw;
  - (3) Against currents greater than one (1) knot unless line-tended; and
  - (4) If a diver cannot directly ascend to the



- surface unless line-tended;
- (b) The SCUBA diver has the equipment required by § 197.346(a);
- (c) A standby diver is available while a diver is in the water;
- (d) A diver is line-tended from the surface or accompanied by another diver in the water in continuous visual contact during the diving operation;
- (e) When a diver is in a physically confining space, another diver is stationed at the underwater point of entry and is line-tending the diver; and
- (f) A boat is available for diver pickup when the divers are not line-tended from the dive location.

### § 197.432 Surface-supplied air diving.

The diving supervisor shall insure that-

- (a) Surface-supplied air diving is conducted at depths less than 190 fsw, except that dives with bottom times of 30 minutes or less may be conducted to depths of 220 fsw;
- (b) Each diving operation has a primary breathing gas supply;
- (c) Each diver is continuously tended while in the water;
- (d) When a diver is in a physically confining space, another diver is stationed at the underwater point of entry and is line-tending the diver;
- (e) For dives deeper than 130 fsw or outside the no-decompression limits-
  - (1) Each diving operation has a secondary breathing gas supply;
  - (2) A decompression chamber is ready for use at the dive location;
  - (3) A diving stage is used except when a bell is provided;
  - (4) A bell is used for dives with an in-water decompression time greater than 120 minutes, except when the diver is using a heavy-weight diving outfit or is diving in a physically confining space;
  - (5) A separate dive team member tends each diver in the water;
  - (6) A standby diver is available while a diver is in the water; and
  - (7) Each diver has a diver-carried reserve breathing gas supply except

when using a heavy-weight diving outfit or when diving in a physically confining space; and

- (f) The surface-supplied air diver has the equipment required by § 197.346(b) or (d).

### § 197.434 Surface-supplied mixed-gas diving.

The diving supervisor shall insure that-

- (a) When mixed-gas diving is conducted, a decompression chamber or a closed bell meeting the requirements of § 197.332 is ready for use at the dive location;
- (b) A diving stage is used except when a bell is provided;
- (c) A bell is used for dives deeper than 220 fsw or when the dive involves in-water decompression times greater than 120 minutes, except when the diver is using a heavy-weight diving outfit or is diving in a physically confining space;
- (d) A closed bell is used for dives at depths greater than 300 fsw, except when diving is conducted in a physically confining space;
- (e) A separate dive team member tends each diver in the water;
- (f) A standby diver is available during all nonsaturation dives;
- (g) When saturation diving is conducted-
  - (1) A standby diver is available when the closed bell leaves the dive location until the divers are in saturation; and
  - (2) A member of the dive team at the dive location is a diver able to assist in the recovery of the closed bell or its occupants, if required;
- (h) When closed bell operations are conducted, a diver is available in the closed bell to assist a diver in the water;
- (i) When a diver is in a physically confining space, another diver is stationed at the underwater point of entry and is line-tending the diver;
- (j) Each diving operation has a primary and secondary breathing gas supply meeting the requirements of § 197.340; and
- (k) The surface-supplied mixed-gas diver has the equipment required by § 197.346(b) or (d).

### § 197.436 Liveboating.

- (a) During liveboating operations, the person-in-charge shall insure that-
  - (1) Diving is not conducted in seas that impede station-keeping ability of the vessel;
  - (2) Liveboating operations are not conducted-
    - (i) From 1 hour after sunset to 1 hour before sunrise; or
    - (ii) During periods of restricted visibility;
  - (3) The propellers of the vessel are stopped before the diver enters or exits the water; and
  - (4) A boat is ready to be launched with crew in the event of an emergency.
- (b) As used in paragraph (a)(2)(ii) of this section, “restricted visibility” means any condition in which vessel navigational visibility is restricted by fog, mist, falling snow, heavy rainstorms, sandstorms or any other similar causes.
- (c) During liveboating operations, the diving supervisor shall insure that-
  - (1) Diving is not conducted at depths greater than 220 fsw;
  - (2) Diving is not conducted in seas that impede diver mobility or work function;
  - (3) A means is used to prevent the diver’s hose from entangling in the propellers of the vessel;
  - (4) Each diver carries a reserve breathing gas supply;
  - (5) A standby diver is available while a diver is in the water;
  - (6) Diving is not conducted with in-water decompression times greater than 120 minutes; and
  - (7) The person-in-charge is notified before a diver enters or exits the water.

## PERIODIC TESTS AND INSPECTIONS OF DIVING EQUIPMENT

### § 197.450 Breathing gas tests.

The diving supervisor shall insure that-

- (a) The output of each air compressor is tested and meets the requirements of § 197.340 for quality and quantity by means of samples taken at the connection point to the distribution system-
  - (1) Every 6 months; and
  - (2) After every repair or modification.
- (b) Purchased supplies of breathing mixtures supplied to a diver are checked before being placed on line for-
  - (1) Certification that the supply meets the requirements of § 197.340; and
  - (2) Noxious or offensive odor and oxygen percentage;
- (c) Each breathing supply system is checked, prior to commencement of diving operations, at the umbilical or underwater breathing apparatus connection point for the diver, for noxious or offensive odor and presence of oil mist; and
- (d) Each breathing supply system, supplying mixed-gas to a diver, is checked, prior to commencement of diving operations, at the umbilical or underwater breathing apparatus connection point for the diver, for percentage of oxygen.

### § 197.452 Oxygen cleaning.

The diving supervisor shall ensure that equipment used with oxygen or oxygen mixtures greater than 40 percent by volume is cleaned of flammable materials-

- (a) Before being placed into service; and
- (b) After any repair, alteration, modification, or suspected contamination.

### § 197.454 First aid and treatment equipment.

The diving supervisor shall ensure that medical kits are checked monthly to insure that all required supplies are present.





### § 197.456 Breathing supply hoses.

- (a) The diving supervisor shall insure that-
  - (1) Each breathing supply hose is pressure tested prior to being placed into initial service and every 24 months thereafter to 1.5 times its maximum working pressure;
  - (2) Each breathing supply hose assembly, prior to being placed into initial service and after any repair, modification, or alteration, is tensile tested by-
    - (i) Subjecting each hose-to-fitting connection to a 200 pound axial load; and
    - (ii) Passing a visual examination for evidence of separation, slippage, or other damage to the assembly;
  - (3) Each breathing supply hose is periodically checked for-
    - (i) Damage which is likely to affect pressure integrity; and
    - (ii) Contamination which is likely to affect the purity of the breathing mixture delivered to the diver; and
  - (4) The open ends of each breathing supply hose are taped, capped, or plugged when not in use.
- (b) To meet the requirements of paragraph (a)(3) of this section, each breathing supply hose must be-
  - (1) Carefully inspected before being shipped to the dive location;
  - (2) Visually checked during daily operation; and
  - (3) Checked for noxious or offensive odor before each diving operation.

### § 197.458 Gages and timekeeping devices.

The diving supervisor shall insure that-

- (a) Each depth gage and timekeeping device is tested or calibrated against a master reference gage or timekeeping device every 6 months;
- (b) A depth gage is tested when a discrepancy exists in a depth gage reading greater than 2 percent of full scale between any two gages of similar range and calibration;

- (c) A timekeeping device is tested when a discrepancy exists in a timekeeping device reading greater than one-quarter of a minute in a 4-hour period between any two timekeeping devices; and
- (d) Each depth gage and timekeeping device is inspected before diving operations are begun.

### § 197.460 Diving equipment.

The diving supervisor shall insure that the diving equipment designated for use in a dive under § 197.346 is inspected before each dive.

### § 197.462 Pressure vessels and pressure piping.

- (a) The diving supervisor shall insure that each volume tank, cylinder, PVHO, and pressure piping system has been examined and tested every 12 months and after any repair, modification, or alteration to the extent necessary to determine that they are in condition and fit for the service intended.
- (b) The following tests must be made to meet the annual requirements of paragraph (a) of this section:
  - (1) An internal and external visual examination for mechanical damage or deterioration. If a defect is found that may impair the safety of the pressure vessel, a hydrostatic test must be performed.
  - (2) A leak test.
  - (3) A pneumatic test.
  - (4) A hydrostatic test every fifth year instead of the pneumatic test.
- (c) The following tests must be made after any repair, modification, or alteration to meet the requirements of paragraph (a) of this section:
  - (1) An internal and external visual examination for correctness and adequacy of repair, modification, or alteration.
  - (2) A leak test.
  - (3) A hydrostatic test when the repair, modification, or alteration affects the pressure boundary.
- (d) When the pneumatic test on pressure vessels is conducted-
  - (1) The test pressure must be the maximum allowable working pressure

- stamped on the pressure vessel; and
  - (2) The test may be conducted only after suitable precautions are taken to protect personnel and equipment.
- (e) When the pneumatic test on pressure piping is conducted-
  - (1) The test pressure must be no less than 90 percent of the setting of the relief device; and
  - (2) The test may be conducted only after suitable precautions are taken to protect personnel and equipment.
- (f) When a hydrostatic test on a pressure vessel is made, the test pressure must be:
  - (1) 11/4 times the pressure stamped on the pressure vessel built to division 2 of the ASME Code; and
  - (2) 11/2 times the pressure stamped on the pressure vessel built to division 1 of the ASME Code.
- (g) When a hydrostatic test on pressure piping is conducted, the test must be conducted in accordance with the ANSI Code.
- (h) When the leak test on pressure vessels or pressure piping is conducted:
  - (1) The test must be conducted with the breathing mixture normally used in service;
  - (2) The test must be conducted at the maximum allowable working pressure; and
  - (3) The test pressure must be maintained for a minimum of 10 minutes to allow checking all joints, connections, and regions of high stress for leakage.

## RECORDS

### § 197.480 Logbooks.

- (a) The person-in-charge of a vessel or facility required by 46 U.S.C. 201 to have an official logbook shall maintain the logbook on form CG-706.
- (b) The person-in-charge of a vessel or facility not required by 46 U.S.C. 201 to have an official logbook, shall maintain, on board, a logbook for making the entries required by this subpart.
- (c) The diving supervisor conducting commercial diving operations from a vessel or facility subject to this subpart shall maintain a logbook for making the entries required by this subpart.

### § 197.482 Logbook entries.

- (a) The person-in-charge shall insure that the following information is recorded in the logbook for each commercial diving operation:
  - (1) Date, time, and location at the start and completion of dive operations.
  - (2) Approximate underwater and surface conditions (weather, visibility, temperatures, and currents).
  - (3) Name of the diving supervisor.
  - (4) General nature of work performed.
- (b) The diving supervisor shall insure that the following information is recorded in the logbook for each commercial diving operation:
  - (1) Date, time, and location at the start and completion of each dive operation.
  - (2) Approximate underwater and surface conditions (weather, visibility, temperatures, and currents).
  - (3) Names of dive team members including diving supervisor.
  - (4) General nature of work performed.
  - (5) Repetitive dive designation or elapsed time since last hyperbaric exposure if less than 24 hours for each diver.
  - (6) Diving modes used.
  - (7) Maximum depth and bottom time for each diver.
  - (8) Name of person-in-charge.
  - (9) For each dive outside the no-decompression limits, deeper than 130 fsw, or using mixed-gas, the breathing gases and decompression table designations used.
  - (10) When decompression sickness or gas embolism is suspected or symptoms are evident-
    - (i) The name of the diver; and
    - (ii) A description and results of treatment.
  - (11) For each fatality or any diving related injury or illness that results in incapacitation of more than 72 hours or requires any dive team member to be hospitalized for more than 24 hours-
    - (i) The date;
    - (ii) Time;
    - (iii) Circumstances; and
    - (iv) Extent of any injury or illness.



(c) The diving supervisor shall insure that the following is recorded in the logbook for each diving operation deviating from the requirements of this subpart:

- (1) A description of the circumstances leading to the situation.
- (2) The deviations made.
- (3) The corrective action taken, if appropriate, to reduce the possibility of recurrence.

(d) The diving supervisor shall insure that a record of the following is maintained:

- (1) The date and results of each check of the medical kits.
- (2) The date and results of each test of the air compressor.
- (3) The date and results of each check of breathing mixtures.
- (4) The date and results of each check of each breathing supply system.
- (5) The date, equipment cleaned, general cleaning procedure, and names of persons cleaning the diving equipment for oxygen service.
- (6) The date and results of each test of the breathing supply hoses and system.
- (7) The date and results of each inspection of the breathing gas supply system.
- (8) The date and results of each test of depth gages and timekeeping devices.
- (9) The date and results of each test and inspection of each PVHO.
- (10) The date and results of each inspection of the diving equipment.
- (11) The date and results of each test and inspection of pressure piping.
- (12) The date and results of each test and inspection of volume tank and cylinders.

(e) The diving supervisor shall insure that a notation concerning the location of the information required under paragraph (d) is made in the logbook.

Note: R.S. 4290 (46 U.S.C. 201) requires that certain entries be made in an official logbook in addition to the entries required by this section; and R.S. 4291 (46 U.S.C. 202) prescribes the manner of making those entries.

### **§ 197.484 Notice of casualty.**

(a) In addition to the requirements of Subpart 4.05 of this chapter and 33 CFR 146.01-20, the person-in-charge shall notify the Officer-in-Charge, Marine Inspection, as soon as possible after a diving casualty occurs, if the casualty involves any of the following:

- (1) Loss of life.
- (2) Diving-related injury to any person causing incapacitation for more than 72 hours.
- (3) Diving-related injury to any person requiring hospitalization for more than 24 hours.

(b) The notice required by this section must contain the following:

- (1) Name and official number (if applicable) of the vessel or facility.
- (2) Name of the owner or agent of the vessel or facility.
- (3) Name of the person-in-charge.
- (4) Name of the diving supervisor.
- (5) Description of the casualty including presumed cause.
- (6) Nature and extent of the injury to persons.

(c) The notice required by this section is not required if the written report required by § 197.486 is submitted within 5 days of the casualty.

### **§ 197.486 Written report of casualty.**

The person-in-charge of a vessel or facility for which a notice of casualty was made under § 197.484 shall submit a report to the Officer-in-Charge, Marine Inspection, as soon as possible after the casualty occurs, as follows:

- (a) On Form CG-2692, when the diving installation is on a vessel.
- (b) Using a written report, in narrative form, when the diving installation is on a facility. The written report must contain the information required by § 197.484.
- (c) The report required by this section must be accompanied by a copy of the report required by § 197.410(a)(9) when decompression sickness is involved.





- (d) The report required by this section must include information relating to alcohol or drug involvement as required by § 4.05-12 of this chapter.

(The reporting requirements in paragraph (a) was approved by OMB under control number 2115-0003)

[CGD 76-009, 43 FR 53683, Nov. 16, 1978, as amended by CGD 82-023, 47 FR 35748, Aug. 16, 1982; 48 FR 43328, Sept. 23, 1983; CGD 84-099, 52 FR 47536, Dec. 14, 1987]

### **§ 197.488 Retention of records after casualty.**

- (a) The owner, agent, or person-in-charge of a vessel or facility for which a report of casualty is made under § 197.484 shall retain all records onboard that are maintained on the vessel or facility and those records required by this subpart for 6 months after the report of a casualty is made or until advised by the Officer-in-Charge, Marine Inspection, that records need not be retained onboard.
- (b) The records required by paragraph (a) of this section to be retained on board include, but are not limited to, the following:
- (1) All logbooks required by § 197.480.
  - (2) All reports required by § 197.402(a)(2)(ii), § 197.404(a)(4), § 197.410(a)(9).
- (c) The owner, agent, person-in-charge, or diving supervisor shall, upon request, make the records described in this section available for examination by any Coast Guard official authorized to investigate the casualty.

## **APPENDIX A AIR NO-DECOMPRESSION LIMITS**

The following table gives the depth versus bottom time limits for single, no-decompression, air dives made within any 12-hour period. The limit is the maximum bottom time in minutes that a diver can spend at that depth without requiring decompression beyond that provided by a normal ascent rate of 60 fsw per minute. (Although bottom time is concluded when ascent begins, a slower ascent rate would increase the bottom time thereby requiring decompression). An amount of nitrogen remains in the tissues of a diver after any air dive, regardless of whether the dive was a decompression or no-decompression dive. Whenever another dive is made within a 12-hour period, the nitrogen remaining in the blood and body tissues of the diver must be considered when calculating his decompression.

### **Air No-Decompression Limits**

Depth (feet):	No-decompression limits (minutes):
35 .....	310
40 .....	200
50 .....	100
60 .....	60
70 .....	50
80 .....	40
90 .....	30
100 .....	25
110 .....	20
120 .....	15
130 .....	10

(Source: U.S. Navy Diving Manual,  
1 September 1973.)

**PARTS 198-199-[RESERVED]**



## **SECTION 15.0**

# **DEPARTMENT OF LABOR**

**Occupational Safety and Health Administration**

**COMMERCIAL DIVING STANDARDS**



**Association of Diving Contractors International**





**U.S. Department of Labor**

Occupational Safety and Health Administration  
Washington, D.C. 20210



Reply to the attention of:

**Oct. 29, 1996**

Mr. Ross Saxon, Executive Director  
Association of Diving Contractors, Inc.  
2611 FM 1960 West, Suite F-204  
Houston, Texas 77068

Dear Mr. Saxon:

This is in response to your request for an interpretation of OSHA's Commercial Diving standards (29 CFR Part 1910, Subpart T), regarding the minimum number of dive team members required to support air dives using scuba equipment and surface-supplied diving equipment. In establishing the required number of dive team members required for a particular situation, proper consideration must be given to §1910.412(d) — "Planning assessment", §1910.421(e) — "Hazardous activities", and §1910.422(a)(3) which requires providing a means to assist an injured diver from the water or into a bell.

Commercial scuba air diving requires a minimum of three (3) dive team members as follows: designated person-in-charge (DPIC) sometimes referred to as the diving supervisor [§1910.410(c)], a stand-by diver [§1910.424(c)(1)], and a line-tended diver [§1910.424(c)(2)]. The stand-by diver can be the DPIC provided that he/she is a qualified diver, and that the third dive team member is trained and capable of performing all necessary functions of the DPIC while the DPIC is in the water as the stand-by-diver. The stand-by-diver can also be the tender provided that he/she is a qualified diver; in this case, the DPIC would assume tending duties when the stand-by-diver is in the water.

Commercial surface-supplied air diving requires a minimum of three (3) dive team members as follows: DPIC sometimes referred to as the diving supervisor [§1910.410(c)], and a diver who "shall be continuously tended (by a tender) while in the water" [§1910.425(c)(1)]. For surface-supplied air diving which is 100 feet or less and does not involve scheduled decompression, a stand-by-diver is not a specified requirement for all dives. Also, based upon the requirements of §1910.421(d), "Planning and assessment", the hazard analysis/assessment of the dive may dictate the use of a stand-by-diver even though not specifically required (e.g., underwater debris, suction, no free access to the surface, possibility of diver entanglement, bottom conditions unknown).

Should you require additional clarification, please contact Mr. Steve Butler at (202) 219-8131 x154 or myself at (202) 219-7234 x141.

Sincerely,  
Larry Liberatore  
Director, Maritime Safety Standards



## TEXT OF THE REGULATION

### OSHA

#### **PART 1910—OCCUPATIONAL SAFETY AND HEALTH STANDARDS** **Subpart T—Commercial Diving Operations**

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##### **APPENDIX B**

Guidelines for scientific diving

#### **Subpart T—Commercial Diving Operations**

Authority: Secs. 4, 6, and 8, of the Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, and 657); sec. 107, Contract Work Hours and Safety Standards Act (the Construction Safety Act) (40 U.S.C. 333); sec. 41, Longshore and Harbor Workers' Compensation Act (33 U.S.C. 941); Secretary of Labor's Order No. 8-76 (41 FR 25059), 9-83 (48 FR 35736), or 1-90 (55 FR 9033), as applicable; 29 CFR part 1911.

Source: 42 FR 37668, July 22, 1977, unless otherwise noted.

##### **GENERAL**

#### **§ 1910.401 Scope and application**

##### *(a) Scope*

- (1) This subpart (standard) applies to every place of employment within the waters of the United States, or within any State, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, American Samoa, Guam, the Trust Territory of the Pacific Islands, Wake Island, Johnston Island, the Canal Zone, or within the Outer Continental Shelf lands as defined in the Outer Continental Shelf Lands Act (67 Stat. 462, 43 U.S.C. 1331), where diving and related support operations are performed.
- (2) This standard applies to diving and related support operations conducted in connection with all types of work and employments, including general industry, construction, ship repairing, shipbuilding, shipbreaking and longshoring. However, this standard does not apply to any diving operation:
  - (i) Performed solely for instructional purposes, using open-circuit, compressed-air SCUBA and conducted within the no-decompression limits;
  - (ii) Performed solely for search, rescue, or related public safety purposes by or under the control of a governmental agency; or
  - (iii) Governed by 45 CFR Part 46 (Protection of Human Subjects, U.S. Department of Health and Human Services) or equivalent rules or regulations established by another federal agency, which regulate research, development, or related purposes involving human subjects.

(iv) Defined as scientific diving and which is under the direction and control of a diving program containing at least the following elements:

(A) Diving safety manual which includes at a minimum: Procedures covering all diving operations specific to the program; procedures for emergency care, including recompression and evacuation; and criteria for diver training and certification.

(B) Diving control (safety) board, with the majority of its members being active divers, which shall at a minimum have the authority to: Approve and monitor diving projects; review and revise the diving safety manual; assure compliance with the manual; certify the depths to which a diver has been trained; take disciplinary action for unsafe practices; and, assure adherence to the buddy system (a diver is accompanied by and is in continuous contact with another diver in the water) for SCUBA diving.

(b) *Application in emergencies.* An employer may deviate from the requirements of this standard to the extent necessary to prevent or minimize a situation which is likely to cause death, serious physical harm, or major environmental damage, provided that the employer:

(1) Notifies the Area Director, Occupational Safety and Health Administration within 48 hours of the onset of the emergency situation indicating the nature of the emergency and extent of the deviation from the prescribed regulations; and

(2) Upon request from the Area Director, submits such information in writing.

(c) *Employer obligation.* The employer shall be responsible for compliance with:

(1) All provisions of this standard of general applicability; and

(2) All requirements pertaining to specific diving modes to the extent diving operations in such modes are conducted.

[42 FR 37668, July 22, 1977, as amended at 47 FR 53365, Nov. 26, 1982; 58 FR 35310, June 30, 1993]

## § 1910.402 Definitions

As used in this standard, the listed terms are defined as follows:

- *Acfm:* Actual cubic feet per minute.
- *ASME Code or equivalent:* ASME (American Society of Mechanical Engineers) Boiler and Pressure Vessel Code, Section VIII, or an equivalent code which the employer can demonstrate to be equally effective.
- *ATA:* Atmosphere absolute.
- *Bell:* An enclosed compartment, pressurized (closed bell) or unpressurized (open bell), which allows the diver to be transported to and from the underwater work area and which may be used as a temporary refuge during diving operations.
- *Bottom time:* The total elapsed time measured in minutes from the time when the diver leaves the surface in descent to the time that the diver begins ascent.
- *Bursting pressure:* The pressure at which a pressure containment device would fail structurally.
- *Cylinder:* A pressure vessel for the storage of gases.
- *Decompression chamber:* A pressure vessel for human occupancy such as a surface decompression chamber, closed bell, or deep diving system used to decompress divers and to treat decompression sickness.
- *Decompression sickness:* A condition with a variety of symptoms which may result from gas or bubbles in the tissues of divers after pressure reduction.
- *Decompression table:* A profile or set of profiles of depth-time relationships for ascent rates and breathing mixtures to be followed after a specific depth-time exposure or exposures.



- *Dive location*: A surface or vessel from which a diving operation is conducted.
- *Dive-location reserve breathing gas*: A supply system of air or mixed-gas (as appropriate) at the dive location which is independent of the primary supply system and sufficient to support divers during the planned decompression.
- *Dive team*: Divers and support employees involved in a diving operation, including the designated person-in-charge.
- *Diver*: An employee working in water using underwater apparatus which supplies compressed breathing gas at the ambient pressure.
- *Diver-carried reserve breathing gas*: A diver-carried supply of air or mixed gas (as appropriate) sufficient under standard operating conditions to allow the diver to reach the surface, or another source of breathing gas, or to be reached by a stand-by-diver.
- *Diving mode*: A type of diving requiring specific equipment, procedures and techniques (SCUBA, surface-supplied air, or mixed gas).
- *Fsw*: Feet of seawater (or equivalent static pressure head).
- *Heavy gear*: Diver-worn deep-sea dress including helmet, breastplate, dry suit, and weighted shoes.
- *Hyperbaric conditions*: Pressure conditions in excess of surface pressure.
- *Inwater stage*: A suspended underwater platform which supports a diver in the water.
- *Liveboating*: The practice of supporting a surfaced-supplied air or mixed gas diver from a vessel which is underway.
- *Mixed-gas diving*: A diving mode in which the diver is supplied in the water with a breathing gas other than air.
- *No-decompression limits*: The depth-time limits of the “no-decompression limits and repetitive dive group designation table for no-decompression air dives”, U.S. Navy Diving Manual or equivalent limits which the employer can demonstrate to be equally effective.
- *Psi(g)*: Pounds per square inch (gauge).
- *Scientific diving*: means diving performed solely as a necessary part of a scientific, research, or educational activity by

employees whose sole purpose for diving is to perform scientific research tasks.

Scientific diving does not include performing any tasks usually associated with commercial diving such as: Placing or removing heavy objects underwater; inspection of pipelines and similar objects; construction; demolition; cutting or welding; or the use of explosives.

- *SCUBA diving*: A diving mode independent of surface supply in which the diver uses open circuit self-contained underwater breathing apparatus.
- *Standby diver*: A diver at the dive location available to assist a diver in the water.
- *Surface-supplied air diving*: A diving mode in which the diver in the water is supplied from the dive location with compressed air for breathing.
- *Treatment table*: A depth-time and breathing gas profile designed to treat decompression sickness.
- *Umbilical*: The composite hose bundle between a dive location and a diver or bell, or between a diver and a bell, which supplies the diver or bell with breathing gas, communications, power, or heat as appropriate to the diving mode or conditions, and includes a safety line between the diver and the dive location.
- *Volume tank*: A pressure vessel connected to the outlet of a compressor and used as an air reservoir.
- *Working pressure*: The maximum pressure to which a pressure containment device may be exposed under standard operating conditions.

[42 FR 37668, July 22, 1977, as amended at 47 FR 53365, Nov. 26, 1982]

## PERSONNEL REQUIREMENTS

### § 1910.410 Qualifications of dive team

#### (a) General.

- (1) Each dive team member shall have the experience or training necessary to perform assigned tasks in a safe and healthful manner.



- (2) Each dive team member shall have experience or training in the following:
  - (i) The use of tools, equipment and systems relevant to assigned tasks;
  - (ii) Techniques of the assigned diving mode; and
  - (iii) Diving operations and emergency procedures.
- (3) All dive team members shall be trained in cardiopulmonary resuscitation and first aid (American Red Cross standard course or equivalent).
- (4) Dive team members who are exposed to or control the exposure of others to hyperbaric conditions shall be trained in diving-related physics and physiology.

(b) *Assignments.*

- (1) Each dive team member shall be assigned tasks in accordance with the employee's experience or training, except that limited additional tasks may be assigned to an employee undergoing training provided that these tasks are performed under the direct supervision of an experienced dive team member.
- (2) The employer shall not require a dive team member to be exposed to hyperbaric conditions against the employee's will, except when necessary to complete decompression or treatment procedures.
- (3) The employer shall not permit a dive team member to dive or be otherwise exposed to hyperbaric conditions for the duration of any temporary physical impairment or condition which is known to the employer and is likely to affect adversely the safety or health of a dive team member.

(c) *Designated person-in-charge.*

- (1) The employer or an employee designated by the employer shall be at the dive location in charge of all aspects of the diving operation affecting the safety and health of dive team members.
- (2) The designated person-in-charge

shall have experience and training in the conduct of the assigned diving operation.

## GENERAL OPERATIONS PROCEDURES

### § 1910.420 Safe practices manual

- (a) *General.* The employer shall develop and maintain a safe practices manual which shall be made available at the dive location to each dive team member.
- (b) *Contents.*
  - (1) The safe practices manual shall contain a copy of this standard and the employer's policies for implementing the requirements of this standard.
  - (2) For each diving mode engaged in, the safe practices manual shall include:
    - (i) Safety procedures and checklists for diving operations;
    - (ii) Assignments and responsibilities of the dive team members;
    - (iii) Equipment procedures and checklists; and
    - (iv) Emergency procedures for fire, equipment failure, adverse environmental conditions, and medical illness and injury.

(The information collection requirements contained in paragraph (b) were approved by the Office of Management and Budget under control number 1218-0069).

[42 FR 37668, July 22, 1977, as amended at 49 FR 18295, Apr. 30, 1984; 61 FR 5507, Feb. 13, 1996]

### § 1910.421 Pre-dive procedures

- (a) *General.* The employer shall comply with the following requirements prior to each diving operation, unless otherwise specified.
- (b) *Emergency aid.* A list shall be kept at the dive location of the telephone or call numbers of the following:
  - (1) An operational decompression chamber (if not at the dive location);
  - (2) Accessible hospitals;



- (3) Available physicians;
- (4) Available means of transportation; and
- (5) The nearest U.S. Coast Guard Rescue Coordination Center.

(c) *First aid supplies.*

- (1) A first aid kit appropriate for the diving operation and approved by a physician shall be available at the dive location.
- (2) When used in a decompression chamber or bell, the first aid kit shall be suitable for use under hyperbaric conditions.
- (3) In addition to any other first aid supplies, an American Red Cross standard first aid hand book or equivalent, and a bag-type manual resuscitator with transparent mask and tubing shall be available at the dive location.

(d) *Planning and assessment.* Planning of a diving operation shall include an assessment of the safety and health aspects of the following:

- (1) Diving mode;
- (2) Surface and underwater conditions and hazards;
- (3) Breathing gas supply (including reserves);
- (4) Thermal protection;
- (5) Diving equipment and systems;
- (6) Dive team assignments and physical fitness of dive team members (including any impairment known to the employer);
- (7) Repetitive dive designation or residual inert gas status of dive team members;
- (8) Decompression and treatment procedures (including altitude corrections); and
- (9) Emergency procedures.

(e) *Hazardous activities.* To minimize hazards to the dive team, diving operations shall be coordinated with other activities in the vicinity which are likely to interfere with the diving operation.

(f) *Employee briefing.*

- (1) Dive team members shall be briefed on:
  - (i) The tasks to be undertaken;
  - (ii) Safety procedures for the diving

mode;

- (iii) Any unusual hazards or environmental conditions likely to affect the safety of the diving operation; and

- (iv) Any modifications to operating procedures necessitated by the specific diving operation.

- (2) Prior to making individual dive team member assignments, the employer shall inquire into the dive team member's current state of physical fitness, and indicate to the dive team member the procedure for reporting physical problems or adverse physiological effects during and after the dive.

(g) *Equipment inspection.* The breathing gas supply system including reserve breathing gas supplies, masks, helmets, thermal protection, and bell handling mechanism (when appropriate) shall be inspected prior to each dive.

(h) *Warning signal.* When diving from surfaces other than vessels in areas capable of supporting marine traffic, a rigid replica of the international code flag "A" at least one meter in height shall be displayed at the dive location in a manner which allows all-round visibility, and shall be illuminated during night diving operations.

(Approved by the office of Management and Budget under control number 1218-0069)

[42 FR 37668, July 22, 1977, as amended at 47 FR 14706, Apr. 6, 1982; 54 FR 24334, June 7, 1989; 61 FR 5507, Feb. 13, 1996]

## **§ 1910.422 Procedures during dive**

(a) *General.* The employer shall comply with the following requirements which are applicable to each diving operation unless otherwise specified.

(b) *Water entry and exit.*

- (1) A means capable of supporting the diver shall be provided for entering and exiting the water.
- (2) The means provided for exiting the water shall extend below the water surface.
- (3) A means shall be provided to assist an injured diver from the water or into a bell.

(c) *Communications.*

(1) An operational two-way voice communication system shall be used between:

(i) Each surface-supplied air or mixed-gas diver and a dive team member at the dive location or bell (when provided or required); and

(ii) The bell and the dive location.

(2) An operational, two-way communication system shall be available at the dive location to obtain emergency assistance.

(d) *Decompression tables.* Decompression, repetitive, and no-decompression tables (as appropriate) shall be at the dive location.

(e) *Dive profiles.* A depth-time profile, including when appropriate any breathing gas changes, shall be maintained for each diver during the dive including decompression.

(f) *Hand-held power tools and equipment.*

(1) Hand-held electrical tools and equipment shall be de energized before being placed into or retrieved from the water.

(2) Hand-held power tools shall not be supplied with power from the dive location until requested by the diver.

(g) *Welding and burning.*

(1) A current supply switch to interrupt the current flow to the welding or burning electrode shall be:

(i) Tended by a dive team member in voice communication with the diver performing the welding or burning; and

(ii) Kept in the open position except when the diver welding or burning.

(2) The welding machine frame shall be grounded.

(3) Welding and burning cables, electrode holders, and connections shall be capable of carrying the maximum current required by the work, and shall be properly insulated.

(4) Insulated gloves shall be provided to divers performing welding and burning operations.

(5) Prior to welding or burning on closed compartments, structures or pipes,

which contain a flammable vapor or in which a flammable vapor may be generated by the work, they shall be vented, flooded, or purged with a mixture of gases which will not support combustion.

(h) *Explosives.*

(1) Employers shall transport, store, and use explosives in accordance with this section and the applicable provisions of §1910.109 and §1926.912 of Title 29 of the Code of Federal Regulations.

(2) Electrical continuity of explosive circuits shall not be tested until the diver is out of the water.

(3) Explosives shall not be detonated while the diver is in the water.

(i) *Termination of dive.* The working interval of a dive shall be terminated when:

(1) A diver requests termination;

(2) A diver fails to respond correctly to communications or signals from a dive team member;

(3) Communications are lost and can not be quickly re-established between the diver and a dive team member at the dive location, and between the designated person-in-charge and the person controlling the vessel in live boating operations; or

(4) A diver begins to use diver-carried reserve breathing gas or the dive-location reserve breathing gas.

## § 1910.423 Post-dive procedures

(a) *General.* The employer shall comply with the following requirements which are applicable after each diving operation, unless otherwise specified.

(b) *Precautions.*

(1) After the completion of any dive, the employer shall:

(i) Check the physical condition of the diver;

(ii) Instruct the diver to report any physical problems or adverse physiological effects including symptoms of decompression sickness;

(iii) Advise the diver of the location of a decompression chamber



which is ready for use; and  
(iv) Alert the diver to the potential hazards of flying after diving.

- (2) For any dive outside the no-decompression limits, deeper than 100 fsw or using mixed gas as a breathing mixture, the employer shall instruct the diver to remain awake and in the vicinity of the decompression chamber which is at the dive location for at least one hour after the dive (including decompression or treatment as appropriate).

(c) *Recompression capability.*

- (1) A decompression chamber capable of recompressing the diver at the surface to a minimum of 165 fsw (6 ATA) shall be available at the dive location for:
- (i) Surface-supplied air diving to depths deeper than 100 fsw and shallower than 220 fsw;
  - (ii) Mixed gas diving shallower than 300 fsw; or
  - (iii) Diving outside the no-decompression limits shallower than 300 fsw.
- (2) A decompression chamber capable of recompressing the diver at the surface to the maximum depth of the dive shall be available at the dive location for dives deeper than 300 fsw.
- (3) The decompression chamber shall be:
- (i) Dual-lock;
  - (ii) Multiplace; and
  - (iii) Located within 5 minutes of the dive location.
- (4) The decompression chamber shall be equipped with:
- (i) A pressure gauge for each pressurized compartment designed for human occupancy;
  - (ii) A built-in-breathing-system with a minimum of one mask per occupant;
  - (iii) A two-way voice communication system between occupants and a dive team member at the dive location;
  - (iv) A viewport; and

(v) Illumination capability to light the interior.

- (5) Treatment tables, treatment gas appropriate to the diving mode, and sufficient gas to conduct treatment shall be available at the dive location.
- (6) A dive team member shall be available at the dive location during and for at least one hour after the dive to operate the decompression chamber (when required or provided).

(d) *Record of dive.*

- (1) The following information shall be recorded and maintained for each diving operation:
- (i) Names of dive team members including designated person-in-charge;
  - (ii) Date, time, and location;
  - (iii) Diving modes used;
  - (iv) General nature of work performed;
  - (v) Approximate underwater and surface conditions (visibility, water temperature and current); and
  - (vi) Maximum depth and bottom time for each diver.
- (2) For each dive outside the no-decompression limits, deeper than 100 fsw or using mixed gas, the following additional information shall be recorded and maintained:
- (i) Depth-time and breathing gas profiles;
  - (ii) Decompression table designation (including modification); and
  - (iii) Elapsed time since last pressure exposure if less than 24 hours or repetitive dive designation for each diver.
- (3) For each dive in which decompression sickness is suspected or symptoms are evident, the following additional information shall be recorded and maintained:
- (i) Description of decompression sickness symptoms (including depth and time of onset); and
  - (ii) Description and results of treat-

ment.

(e) *Decompression procedure assessment.* The employer shall:

- (1) Investigate and evaluate each incident of decompression sickness based on the recorded information, consideration of the past performance of decompression table used, and individual susceptibility;
- (2) Take appropriate corrective action to reduce the probability of recurrence of decompression sickness; and
- (3) Prepare a written evaluation of the decompression procedure assessment, including any corrective action taken, within 45 days of the incident of decompression sickness.

(The information collection requirements contained in paragraphs (d) and (e) were approved by the Office of Management and Budget under control number 1218-0069.)

[42 FR 37668, July 22, 1977, as amended at 49 FR 18295, Apr. 30, 1984; 61 FR 5507, Feb. 13, 1996]

## SPECIFIC OPERATIONS PROCEDURES

### § 1910.424 SCUBA diving

(a) *General.* Employers engaged in SCUBA diving shall comply with the following requirements, unless otherwise specified.

(b) *Limits.* SCUBA diving shall not be conducted:

- (1) At depths deeper than 130 fsw;
- (2) At depths deeper than 100 fsw or outside the no-decompression limits unless a decompression chamber is ready for use;
- (3) Against currents exceeding one (1) knot unless line-tended; or
- (4) In enclosed or physically confining spaces unless line-tended.

(c) *Procedures.*

- (1) A stand-by-diver shall be available while a diver is in the water.
- (2) A diver shall be line-tended from the surface, or accompanied by another diver in the water in continuous visual contact during the diving

operations.

(3) A diver shall be stationed at the underwater point of entry when diving is conducted in enclosed or physically confining spaces.

(4) A diver-carried reserve breathing gas supply shall be provided for each diver consisting of:

- (i) A manual reserve (J valve); or
- (ii) An independent reserve cylinder with a separate regulator or connected to the underwater breathing apparatus.

(5) The valve of the reserve breathing gas supply shall be in the closed position prior to the dive.

### § 1910.425 Surface-supplied air diving

(a) *General.* Employers engaged in surface-supplied air diving shall comply with the following requirements, unless otherwise specified.

(b) *Limits.*

(1) Surface-supplied air diving shall not be conducted at depths deeper than 190 fsw, except that dives with bottom times of 30 minutes or less may be conducted to depths of 220 fsw.

(2) A decompression chamber shall be ready for use at the dive location for any dive outside the no-decompression limits or deeper than 100 fsw.

(3) A bell shall be used for dives with an inwater decompression time greater than 120 minutes, except when heavy gear is worn or diving is conducted in physically confining spaces.

(c) *Procedures.*

(1) Each diver shall be continuously tended while in the water.

(2) A diver shall be stationed at the underwater point of entry when diving is conducted in enclosed or physically confining spaces.

(3) Each diving operation shall have a primary breathing gas supply sufficient to support divers for the duration of the planned dive including decompression.

(4) For dives deeper than 100 fsw or





outside the no-decompression limits:

- (i) A separate dive team member shall tend each diver in the water;
  - (ii) A stand-by-diver shall be available while a diver is in the water;
  - (iii) A diver-carried reserve breathing gas supply shall be provided for each diver except when heavy gear is worn; and
  - (iv) A dive-location reserve breathing gas supply shall be provided.
- (5) For heavy-gear diving deeper than 100 fsw or outside the no-decompression limits:
- (i) An extra breathing gas hose capable of supplying breathing gas to the diver in the water shall be available to the stand-by diver.
  - (ii) An inwater stage shall be provided to divers in the water.
- (6) Except when heavy gear is worn or where physical space does not permit, a diver-carried reserve breathing gas supply shall be provided whenever the diver is prevented by the configuration of the dive area from ascending directly to the surface.

### § 1910.426 Mixed-gas diving

- (a) *General.* Employers engaged in mixed-gas diving shall comply with the following requirements, unless otherwise specified.
- (b) *Limits.* Mixed-gas diving shall be conducted only when:
- (1) A decompression chamber is ready for use at the dive location; and
    - (i) A bell is used at depths greater than 220 fsw or when the dive involves inwater decompression time of greater than 120 minutes, except when heavy gear is worn or when diving in physically confining spaces; or
    - (ii) A closed bell is used at depths greater than 300 fsw, except

when diving is conducted in physically confining spaces.

#### (c) *Procedures.*

- (1) A separate dive team member shall tend each diver in the water.
- (2) A stand-by-diver shall be available while a diver is in the water.
- (3) A diver shall be stationed at the underwater point of entry when diving is conducted in enclosed or physically confining spaces.
- (4) Each diving operation shall have a primary breathing gas supply sufficient to support divers for the duration of the planned dive including decompression.
- (5) Each diving operation shall have a dive-location reserve breathing gas supply.
- (6) When heavy gear is worn:
  - (i) An extra breathing gas hose capable of supplying breathing gas to the diver in the water shall be available to the stand by diver; and
  - (ii) An inwater stage shall be provided to divers in the water.
- (7) An inwater stage shall be provided for divers without access to a bell for dives deeper than 100 fsw or outside the no-decompression limits.
- (8) When a closed bell is used, one dive team member in the bell shall be available and tend the diver in the water.
- (9) Except when heavy gear is worn or where physical space does not permit, a diver-carried reserve breathing gas supply shall be provided for each diver:
  - (i) Diving deeper than 100 fsw or outside the no-decompression limits; or
  - (ii) Prevented by the configuration of the dive area from directly ascending to the surface.

### § 1910.427 Liveboating

- (a) *General.* Employers engaged in diving oper-

ations involving liveboating shall comply with the following requirements.

(b) *Limits.* Diving operations involving live boating shall not be conducted:

- (1) With an inwater decompression time of greater than 120 minutes;
- (2) Using surface-supplied air at depths deeper than 190 fsw, except that dives with bottom times of 30 minutes or less may be conducted to depths of 220 fsw;
- (3) Using mixed gas at depths greater than 220 fsw;
- (4) In rough seas which significantly impede diver mobility or work function; or
- (5) In other than daylight hours.

(c) *Procedures.*

- (1) The propeller of the vessel shall be stopped before the diver enters or exits the water.
- (2) A device shall be used which minimizes the possibility of entanglement of the diver's hose in the propeller of the vessel.
- (3) Two-way voice communication between the designated person-in-charge and the person controlling the vessel shall be available while the diver is in the water.
- (4) A stand-by-diver shall be available while a diver is in the water.
- (5) A diver-carried reserve breathing gas supply shall be carried by each diver engaged in live boating operations.

## EQUIPMENT PROCEDURES AND REQUIREMENTS

### § 1910.430 Equipment

(a) *General.*

- (1) All employers shall comply with the following requirements, unless otherwise specified.
- (2) Each equipment modification, repair, test, calibration or maintenance service shall be recorded by means of a tagging or logging system, and include the date and nature of work performed, and the name or initials of the person performing the work.

(b) *Air compressor system.*

- (1) Compressors used to supply air to the diver shall be equipped with a volume tank with a check valve on the inlet side, a pressure gauge, a relief valve, and a drain valve.
- (2) Air compressor intakes shall be located away from areas containing exhaust or other contaminants.
- (3) Respirable air supplied to a diver shall not contain:
  - (i) A level of carbon monoxide (CO) greater than 20 p/m;
  - (ii) A level of carbon dioxide (CO<sub>2</sub>) greater than 1,000 p/m;
  - (iii) A level of oil mist greater than 5 milligrams per cubic meter; or
  - (iv) A noxious or pronounced odor.
- (4) The output of air compressor systems shall be tested for air purity every 6 months by means of samples taken at the connection to the distribution system, except that non-oil lubricated compressors need not be tested for oil mist.

(c) *Breathing gas supply hoses.*

- (1) Breathing gas supply hoses shall:
  - (i) Have a working pressure at least equal to the working pressure of the total breathing gas system;
  - (ii) Have a rated bursting pressure at least equal to 4 times the working pressure;
  - (iii) Be tested at least annually to 1.5 times their working pressure; and
  - (iv) Have their open ends taped, capped or plugged when not in use.
- (2) Breathing gas supply hose connectors shall:
  - (i) Be made of corrosion-resistant materials;
  - (ii) Have a working pressure at least equal to the working pressure of the hose to which they are attached; and
  - (iii) Be resistant to accidental disengagement.
- (3) Umbilicals shall:
  - (i) Be marked in 10-ft. increments to 100 feet beginning at the



diver's end, and in 50 ft. increments thereafter;

- (ii) Be made of kink-resistant materials; and
- (iii) Have a working pressure greater than the pressure equivalent to the maximum depth of the dive (relative to the supply source) plus 100 psi.

(d) *Buoyancy control.*

- (1) Helmets or masks connected directly to the dry suit or other buoyancy changing equipment shall be equipped with an exhaust valve.
- (2) A dry suit or other buoyancy-changing equipment not directly connected to the helmet or mask shall be equipped with an exhaust valve.
- (3) When used for SCUBA diving, a buoyancy compensator shall have an inflation source separate from the breathing gas supply.
- (4) An inflatable flotation device capable of maintaining the diver at the surface in a face-up position, having a manually activated inflation source independent of the breathing supply, an oral inflation device, and an exhaust valve shall be used for SCUBA diving.

(e) *Compressed gas cylinders.* Compressed gas cylinders shall:

- (1) Be designed, constructed and maintained in accordance with the applicable provisions of 29 CFR 1910.101 and 1910.169 through 1910.171.
- (2) Be stored in a ventilated area and protected from excessive heat;
- (3) Be secured from falling; and
- (4) Have shut-off valves recessed into the cylinder or protected by a cap, except when in use or manifolded, or when used for SCUBA diving.

(f) *Decompression chambers.*

- (1) Each decompression chamber manufactured after the effective date of this standard, shall be built and maintained in accordance with the ASME Code or equivalent.
- (2) Each decompression chamber manufactured prior to the effective date of this standard shall be maintained in

conformity with the code requirements to which it was built, or equivalent.

(3) Each decompression chamber shall be equipped with:

- (i) Means to maintain the atmosphere below a level of 25 percent oxygen by volume;
- (ii) Mufflers on intake and exhaust lines, which shall be regularly inspected and maintained;
- (iii) Suction guards on exhaust line openings; and
- (iv) A means for extinguishing fire, and shall be maintained to minimize sources of ignition and combustible material.

(g) *Gauges and timekeeping devices.*

- (1) Gauges indicating diver depth which can be read at the dive location shall be used for all dives except SCUBA.
- (2) Each depth gauge shall be dead-weight tested or calibrated against a master reference gauge every 6 months, and when there is a discrepancy greater than two percent (2 percent) of full scale between any two equivalent gauges.
- (3) A cylinder pressure gauge capable of being monitored by the diver during the dive shall be worn by each SCUBA diver.
- (4) A timekeeping device shall be available at each dive location.

(h) *Masks and helmets.*

- (1) Surface-supplied air and mixed-gas masks and helmets shall have:
  - (i) A non-return valve at the attachment point between helmet or mask and hose which shall close readily and positively; and
  - (ii) An exhaust valve.
- (2) Surface-supplied air masks and helmets shall have a minimum ventilation rate capability of 4.5 acfm at any depth at which they are operated or the capability of maintaining the diver's inspired carbon dioxide partial pressure below 0.02 ATA when the diver is producing carbon dioxide at the rate of 1.6 standard liters per



minute.

(i) *Oxygen safety.*

- (1) Equipment used with oxygen or mixtures containing over forty percent (40%) by volume oxygen shall be designed for oxygen service.
- (2) Components (except umbilicals) exposed to oxygen or mixtures containing over forty percent (40%) by volume oxygen shall be cleaned of flammable materials before use.
- (3) Oxygen systems over 125 psig and compressed air systems over 500 psig shall have slow-opening shut-off valves.

(j) *Weights and harnesses.*

- (1) Except when heavy gear is worn, divers shall be equipped with a weight belt or assembly capable of quick release.
- (2) Except when heavy gear is worn or in SCUBA diving, each diver shall wear a safety harness with:
  - (i) A positive buckling device;
  - (ii) An attachment point for the umbilical to prevent strain on the mask or helmet; and
  - (iii) A lifting point to distribute the pull force of the line over the diver's body.

(The information collection requirements contained in paragraph (a)(2) were approved by the Office of Management and Budget under control number 1218-0069.)

[39 FR 23502, June 27, 1974, as amended at 49 FR 18295, Apr. 30, 1984; 51 FR 33033, Sept. 18, 1986; 61 FR 5507, Feb. 13, 1996]

## RECORDKEEPING

### § 1910.440 Recordkeeping requirements

- (a)
  - (1) [Reserved]
  - (2) The employer shall record the occurrence of any diving-related injury or illness which requires any dive team member to be hospitalized for 24 hours or more, specifying the circumstances of the incident and the extent of any injuries or illnesses.

(b) *Availability of records.*

- (1) Upon the request of the Assistant Secretary of Labor for Occupational Safety and Health, or the Director, National Institute for Occupational Safety and Health, Department of Health and Human Services of their designees, the employer shall make available for inspection and copying any record or document required by this standard.
- (2) Records and documents required by this standard shall be provided upon request to employees, designated representatives, and the Assistant Secretary in accordance with 29 CFR 1910.20 (a)-(e) and (g)-(i) Safe practices manuals (§1910.420), depth-time profiles (§1910.422), recordings of dives (§1910.423), decompression procedure assessment evaluations (§1910.423), and records of hospitalizations (§1910.440) shall be provided in the same manner as employee exposure records or analyses using exposure or medical records. Equipment inspections and testing records which pertain to employees (§1910.430) shall also be provided upon request to employees and their designated representatives.
- (3) Records and documents required by this standard shall be retained by the employer for the following period:
  - (i) Dive team member medical records (physician's reports) (§1910.411) - 5 years;
  - (ii) Safe practices manual (§1910.420) - current document only;
  - (iii) Depth-time profile (§1910.422) - until completion of the recording of dive, or until completion of decompression procedure assessment where there has been an incident of decompression sickness;
  - (iv) Recording of dive (§1910.423) - 1 year, except 5 years where there has been an incident of decompression sickness;
  - (v) Decompression procedure



- assessment evaluations (§1910.423) - 5 years;
- (vi) Equipment inspections and testing records (§1910.430) - current entry or tag, or until equipment is withdrawn from service;
- (vii) Records of hospitalizations (§1910.440) - 5 years.
- (4) After the expiration of the retention period of any record required to be kept for five (5) years, the employer shall forward such records to the National Institute for Occupational Safety and Health, Department of Health and Human Services. The employer shall also comply with any additional requirements set forth at 29 CFR 1910.20(h).
- (5) In the event the employer ceases to do business:
  - (i) The successor employer shall receive and retain all dive and employee medical records required by this standard; or
  - (ii) If there is no successor employer, dive and employee medical records shall be forwarded to the National Institute for Occupational Safety and Health, Department of Health and Human Services.

[42 FR 37668, July 22, 1977, as amended at 45 FR 35281, May 23, 1980; 47 FR 14706, Apr. 6, 1982; 51 FR 34562, Sept. 29, 1986; 61 FR 5507, Feb. 13, 1996; 61 FR 9227, March 7, 1996]

### § 1910.441 Effective date

This standard shall be effective on October 20, 1977, except that for provisions where decompression chambers or bells are required and such equipment is not yet available, employers shall comply as soon as possible thereafter but in no case later than 6 months after the effective date of the standard.

## APPENDIX A

### Examples of conditions which may restrict or limit exposure to hyperbaric conditions

Appendix A to 1910 Subpart T - Examples of conditions which may restrict or limit exposure to hyperbaric conditions

The following disorders may restrict or limit occupational exposure to hyperbaric conditions depending on severity, presence of residual effects, response to therapy, number of occurrences, diving mode, or degree and duration of isolation.

History of seizure disorder other than early febrile convulsions.

Malignancies (active) unless treated and without recurrence for 5 yrs.

Chronic inability to equalize sinus and/or middle ear pressure.

Cystic or cavitory disease of the lungs.

Impaired organ function caused by alcohol or drug use.

Conditions requiring continuous medication for control (e.g., antihistamines, steroids, barbiturates, moodaltering drugs, or insulin).

Meniere's disease.

Hemoglobinopathies.

Obstructive or restrictive lung disease.

Vestibular end organ destruction.

Pneumothorax.

Cardiac abnormalities (e.g., pathological heart block, valvular disease, intraventricular conduction defects other than isolated right bundle branch block, angina pectoris, arrhythmia, coronary artery disease).

Juxta-articular osteonecrosis.

## APPENDIX B

### Guidelines for scientific diving

This appendix contains guidelines that will be used in conjunction with 1910.401(a)(2)(iv) to determine those scientific diving programs which are exempt from the requirements for commercial diving. The guidelines are as follows:

1. The Diving Control Board consists of a majority of active scientific divers and has autonomous and absolute authority over the scientific diving program's operations.
2. The purpose of the project using scientific diving is the advancement of science; therefore, information and data resulting from the project are non-proprietary.
3. The tasks of a scientific diver are those of an observer and data gatherer. Construction and trouble-shooting tasks traditionally associated with commercial diving are not included within scientific diving.
4. Scientific divers, based on the nature of their activities, must use scientific expertise in studying the underwater environment and, therefore, are scientists or scientists in training.

[50 FR 1050, Jan. 9, 1985]





## SECTION 16.0

# GLOSSARY





**ACFM (acfm)**

Actual cubic feet per minute. Refers to the actual volume of gas supplied to a diver, bell, etc. at ambient pressure.

**Ambient Pressure**

The surrounding pressure at depth (actual or simulated, in a hyperbaric chamber) to which the diver, bell, etc. is subjected.

**Appropriate Breathing Mix**

A breathing mixture which, having regard to the system and equipment used in the diving operations, the work undertaken in those operations, and the conditions in which and the depth at which they are to be carried out, is suitable in content and temperature and of adequate pressure.

**Ascent Times**

The time interval between leaving the bottom when the dive is terminated and reaching the surface.

**ATA (ata)**

Atmosphere absolute. Total pressure, including atmospheric, to which a diver, bell, etc. is subjected.

**ATM (atm)**

Atmospheric (atm) unit equivalent to 14.7 psi or 760 (mm) of mercury.

**Bailout**

An emergency situation where a diver leaves bottom and comes directly to the surface, exceeding normal controlled ascent rates and missing scheduled decompression water stops.

**Bailout Bottle**

See **Diver-Carried Reserve Breathing Gas**.

**Bell**

An enclosed compartment, pressurized (closed bell) or un-pressurized (open bell), which allows the diver to be transported to and from the underwater work area and which may be used as a temporary refuge during diving operations. A Class I bell is an open bell. A Class II bell is fitted with a lower hatch and can be closed.

**Bends**

See **Decompression Sickness**.

**BIBS**

Built-In Breathing System. A breathing gas system built into all deck chambers and SDC's by which emergency breathing gas or a treatment gas can be supplied to the diver through an oral-nasal mask or hood.

**Bottom Time**

The total elapsed time measured in minutes from the time that the diver leaves the surface in descent to the time that the diver begins ascent.

**Breathing System**

Device or apparatus for delivering respirable breathing mixture.

**Bursting Pressure**

The pressure at which a pressure containment device would fail structurally.

**Certified Commercial Diver**

An individual who has applied for and been awarded a certification card or other document recognized to reflect the formal training, field experience, on-the-job performance, and capabilities, of the individual.

**Cleaned for Oxygen Service**

Cleaning of equipment or system to ensure elimination of all hydrocarbons and other potentially dangerous contaminants when system is to be used in oxygen service. See also **Oxygen Cleaning**.

**CNS**

Central Nervous System.

**Commercial Diver**

An individual who has been formally trained in commercial diving at an accredited training school, a military school, or in some other manner meeting documented criteria to show a minimum of 317 hours of combined classroom and practical training meeting the equivalent criteria defined in this standard.

**Compressor**

A machine that raises air or other gases to a pressure above one atmosphere.

**CPR**

Cardio-Pulmonary Resuscitation. A combination of artificial respiration and artificial circulation.

**Cylinder**

A pressure vessel for the storage of gases.

**DDC**

Deck Decompression Chamber — DDC (deck decompression chamber), PVHO (Pressure Vessel for Human Occupancy). A deck chamber capable of controlled pressurization and depressurization used for decompression, recompression, treatment of diving injuries, submarine medicine, or as a surface habitat for saturation divers.

**Decompression**

Releasing from pressure or compression following a specific decompression table or procedure during ascent; ascending in the water or experiencing decreasing pressure in the chamber.

**Decompression Chamber**

See **Deck Decompression Chamber**.

**Decompression Schedule**

A time-depth profile with a specific bottom time and depth, whose application is calculated to reduce the pressure on a diver safely.

**Decompression Sickness**

A condition with a variety of symptoms which causes the formation of bubbles of gas in the blood or other tissues of the diver during or subsequent to ascent or other pressure reduction.



**Decompression Table**

A set of decompression schedules computed on a common protocol.

**Dive Location**

The vessel or other structure from which dives are conducted and supported. More specifically, the point from which the actual dive is controlled.

**Dive Station**

The site from which diving operations are directly controlled. This site shall also include any auxiliary or peripheral equipment necessary to the conduct of the diving operation.

**Dive Team**

Tender/Divers, divers, and diver support personnel involved in a diving operation, including the Diving Supervisor.

**Diver-Worn Equipment**

That equipment required for the safety and well-being of the diver, worn or attached to the diver while underwater.

**Diver's Indicator Light**

A light attached to a diver for the purpose of indicating the position of the diver when he is on the surface of the water.

**Diving Bell**

See **Bell and Submersible Decompression Chamber/SDC**.

**Diving Operations**

Any work operation requiring some type of diving or work underwater that involves planned human exposure to increased pressures to perform the job.

**Diving Operating Personnel**

Any member of the dive team whose activities are regularly scheduled as necessary to conduct diving operations at or from the dive station.

**Diving Superintendent**

The Superintendent or designated Diving Supervisor having complete responsibility for the safety of the diving operation including the responsibility for the safety and health of all diving personnel.

**Dry Suit**

A diving suit designed to exclude water from the surface of the body.

**D.S.**

Dive Supervisor.

**Exhaust Valve**

A valve controlling the venting of gas from any higher pressure source such as a DDC, diver's helmet, suit, buoyancy system, volume tank, etc.

**Embolism**

See **Gas Embolism**.

**Fizzing**

A general feeling of itchiness or sensation of skin irritation.

**FSW (fsw)**

A foot of seawater. A unit of pressure at sea level generally defined as representing the pressure exerted by a foot of seawater having a specific gravity of 1.027, and is equal to approximately 0.445 pounds per square inch.

**Gas Embolism**

A condition caused by expanding gases which have been taken into and retained in the lungs while breathing under pressure, being forced into the bloodstream or other tissues during ascent or decompression.

**Harness**

The combination of straps and fasteners used to attach equipment and umbilical to the diver which can be utilized as a lifting point to remove the diver from the water in the event of an emergency.

**Helium Unscrambler — Unscrambler — Speech Unscrambler**

An electronic device designed to render intelligible the words spoken in a helium hyperbaric environment.

**High Pressure Nervous Syndrome (HPNS)**

A group of symptoms including a lack of coordination, tremors of the extremities, disorientation, nausea, dizziness, and brief lapses of consciousness occurring at depths of 500 feet or deeper.

**Hyperbaric Conditions**

Pressure conditions in excess of surface pressure.

**Hypothermia**

Profound loss of body heat.

**Kluge Hose**

See **Pneumofathometer**.

**Life Support Technician**

Responsible for safe operation of hyperbaric system chambers who reports to Diving Supervisor.

**Liveboating**

The practice of supporting a diver from a vessel which is underway.

**LSI**

Life Support Technician/Rack Operator.

**Master**

Normally considered to be the Person in Charge of a marine asset.

**M.A.W.P.**

Maximum allowable working pressure. See **Maximum Working Pressure**.

**Maximum Working Pressure**

The maximum pressure to which a pressure containment device can be exposed under operating conditions (usually the pressure setting of the pressure relief device).

**Mixed Gas Diving**

A diving technique in which the diver is supplied with a gas mixture other than air for respiration.

**Multiplace**

A decompression chamber designed to be used by more than one person at a time.

**Niggles**

A general feeling of itchiness or sensation of skin irritation.

**No-Decompression Diving**

Diving which involves depths and times shallow and short enough so that the ascent can be made to the surface without water stops or subsequent chamber decompression.

**Non-return Valve (Check Valve)**

A one-way check valve installed in a fluid or gas system to permit flow in one direction only. All diving helmets must have a non-return valve at the gas supply inlet to prevent depressurization of the helmet and the resultant squeeze, should the gas supply be lost.

**Overbottom Pressure**

That pressure above ambient, at which a breathing gas supply must be supplied to the helmet/mask so that the diver will have a sufficient supply of gas.

**Oxygen Cleaning**

Special cleaning process for equipment to be used in oxygen systems which removes all flammables.

**Oxygen Compatibility**

The ability of a substance to come in contact with high pressure oxygen without ignition.

**Oxygen Toxicity**

A medical emergency resulting in convulsions and unconsciousness if gone unchecked; caused by breathing a high partial pressure of oxygen under pressure.

**Partial Pressure**

That portion of the total gas pressure exerted by a particular constituent of the breathing mixture.

**Person in Charge (Master — Barge Captain — Installation Manager)**

In relation to the craft/barge/structure, includes the captain or any other person made responsible by the owner for the vessel or facility, its operation, and the safety, health, and welfare of those on board.

**Pneumofathometer — Kluge — Pneumo**

A depth measuring device consisting of an open-end hose fixed to the diver, with the surface end connected to a gas supply and pressure gauge (usually marked in fsw). Gauge measures pressure required to discharge water to depth of diver.

**PSI (psi)**

Pounds per square inch. An expression of pressure, for example, one atmosphere equals 14.7 psi.

**PVHO**

Pressure Vessel for Human Occupancy. See **Deck Decompression Chamber**.

**Rack Operator**

See **Life Support Technician**.

**Relief Valve**

A pressure-relieving device that prevents pressure from rising above a preset level.

**Saturation Diving**

Procedures in accordance with which a diver is continuously subjected to an ambient pressure greater than atmospheric pressure so that his body tissues and blood become saturated with the constituent elements of the breathing gas. Once the diver's body becomes saturated, he can remain within a specified zone for an unlimited time without incurring any additional decompression obligation.

**Scuba**

Acronym for Self Contained Underwater Breathing Apparatus. Used to describe apparatus in which the inspired air is delivered by demand regulator and exhaled into the surrounding water (open-circuit); the air supply is carried on the diver's back. Primarily used for relatively shallow recreational-related diving.

**Squeeze**

A lack of equalization between parts of the body or between the body and equipment. Extreme cases can cause severe injury or death.

**Standby Diver(s)**

Another qualified diver at the dive location who in a state of readiness to go to the assistance of the diver in the water.

**SDC (Submersible Decompression Chamber) — SCC (Submersible Compression Chamber)**

A pressurized bell in which the divers can be transferred to the underwater work site and return to the surface under pressure.

**Surface-Supplied Diving**

A diving mode in which the diver receives his breathing gas from a supply on the surface.

**Treatment Tables**

A depth, time, and breathing gas profile designed to treat a diver for gas embolism or decompression sickness.

**Umbilical**

A hose bundle between the dive location and the diver and bell that supplies a lifeline, breathing gas, communications, power, and heat as appropriate to the diving mode or conditions. Underwater television camera, etc. cabling can also be carried as a component part of the umbilical or can be taped or banded to same on a temporary basis.

**Unlimited Duration Excursion Tables**

Two tables for use with saturation excursion diving which limit upward and downward excursions, and provide a zone in which the diver can move freely without regard to the number of excursions or their duration without incurring a decompression penalty.

**Valve**

A device that starts, stops, or regulates the flow of fluids.

**Volume Tank**

A pressure vessel connected to the outlet of a gas supply and used as a gas reservoir.

**Weight Belt**

A belt worn by a diver to achieve desired buoyancy.

**Working Pressure**

The pressure to which a pressure containment device is exposed under normal operating conditions.

**Work Site**

An underwater location where work is performed.

